

A BIOSYSTEMATIC REVIEW OF THE BLOODSUCKING PSYCHODID FLIES OF  
COLOMBIA (DIPTERA: PHLEBOTOMINAE AND SYCORACTINAE)

By

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Dedicated to my father,

Howard G. Young

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COLOMBIA (DIPTERA: PHLEBOTOMINAE AND SYCORACINAE)

By

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The psychodid subfamily Sycoracinae, previously unknown in Colombia, is represented by four new *Sycorax* species described and illustrated in this review.

Phlebotominae, a much larger subfamily containing vectors of human pathogens, is represented in the Republic by 101 species and subspecies -- a number equivalent to one-third of the described New World taxa. Ten of these in the genus *Lutzomyia* are described as new and are given formal or informal names. The previously unknown females of *Lutzomyia pilosa*, *L. (P.) hirsuta nicaraguensis* and *L. bifoliata* are described. Nineteen phlebotomine species are reported in Colombia for the first time. Other new distributional records include those from Ecuador (22 spp.), Panama (3 spp.), Honduras (2 spp.), Costa Rica, Cuba, Guatemala, and Paraguay (1 sp. each). In order to clarify the status of some forms, an attempt was made to study specimens from as many Colombian and non-Colombian localities as possible. To this end, over 20,000 adults in both subfamilies were examined from 1967 to the present.



An extensive bibliography and synonymy is given for each previously described taxon. Actual and/or probable misidentifications in the literature are discussed. Identification keys, previously unavailable for the Colombian fauna, are provided along with numerous illustrations, most of which are original.

Although more information is needed, it is suggested that recent speciation in the neotropical phlebotominae was due to climate changes in the Pleistocene (refuge theory).

## INTRODUCTION

Prior to the last decade, we knew very little about the phlebotomine sand fly\* fauna of Colombia. Osorno et al. (1967) in reviewing previous studies by others and adding records of their own, reported less than 25 species in the Republic. From 1967 to 1972, the late Dr. E. Osorno-Mesa and his colleagues at Instituto Nacional de Salud, Bogota added more records, bringing the total to 77 species and subspecies (Osorno et al., 1972a).

In this review 101 species and subspecies of Phlebotominae are reported from Colombia. This represents about one-third of the described New World species but I estimate that at least 40 additional species will be discovered in the Republic, especially in the little-collected south-eastern region.

The small subfamily Sycoracinae, whose members resemble those of Phlebotominae in being able to take vertebrate blood, is treated here for this reason.

In order to clarify the status of some taxa and to study intraspecific variation and distributional patterns, an effort was made to examine specimens from as many Colombian and non-Colombian localities as possible. To this end, I am very grateful to the following persons for providing specimens, information or both: Dr. Jorge R. Arias, Instituto Nacional de Pesquisas da Amazonia (INPA), Manaus; Drs. Stephen C. Ayala and Pablo

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\*I prefer to separate "sand" from "fly" in accordance with the suggestion of Borrer, Delong, and Triplehorn (1976).

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Holotypes and allotypes of new taxa are to be deposited in the U.S. National Museum (Nat. Hist.). Paratypes, when available, will be held by the following institutions: Instituto Nacional de Salud, Bogota; Florida State Collection of Arthropods, Gainesville; and British Museum (Nat. Hist.), London. The remaining 20,000+ specimens, upon which most of this review is based, are stored in the author's personal collection. A synoptic collection will be given to the Instituto Nacional de Salud, Bogota.

## CLASSIFICATION AND TAXONOMIC TREATMENT

Of the 6 recognized subfamilies of Psychodidae (Duckhouse, 1972, 1973), all but one, Horaiellinae from the Oriental Region, are represented in continental Colombia. The species of *Horziella*, *Trichomyia*, and *Sycorax* and its allies are united by some in the subfamily Trichomyiinae but this appears to be artificial and does not "express the wide discontinuities and degrees of difference from other Psychodidae, especially in the immature stages" (Duckhouse, 1972).

The classification of Phlebotominae is interpreted differently according to author(s). In a recent paper we reviewed most classificatory schemes and proposed one which is used here for the New World taxa (Lewis et al., 1978). It is essentially a modification of Theodor's 1965 classification. Three American genera are recognized -- *Lutzomyia* França (ca. 290 spp.), *Brumptomyia* França and Parrot (ca. 23 spp.), *Warileya* Hertig (5 spp.). The genus *Hertigia* Fairchild is considered to be a junior synonym of *Warileya* by Lewis et al. (1978).

The majority of the *Lutzomyia* spp. were described originally in the genus *Phlebotomus* (= *Flebotomus*) Rondani. Some authors continue to place them in this genus, ignoring the evidence to the contrary provided by Theodor (1948, 1965) and Christensen et al. (1971).

The large genus *Lutzomyia* is divided into numerous subgenera, species groups, and series based upon adult morphology (Lewis et al., 1978). The diversity of groups within the genus is attributed to "radiation or even 'explosive radiation' of some immigrating ancestral stocks in a newly

colonized area having a wealth of ecological niches" (Theodor, 1965). This implies that these ancestral stocks originated in the Old World -- a hypothesis which may never be proven. It would appear that recent speciation in some groups (e.g. subgenus *Trichophoromyia*) may have been due to climatic changes in the past, especially during the Pleistocene, which served to isolate conspecific populations in moist refugia during dry periods (Haffer, 1974).

Other remarks on the classification of New World phlebotomines are given by Lewis et al. (1978) and in this review under each supraspecific taxon.

An extensive bibliography and synonymy is given for most taxa treated here. I usually omitted references which contain species lists but some of them including those by Fairchild (1955), Barretto (1955a, 1962), Theodor (1965), and Martins & Morales (1972) are very important because of discussions related to classification and distribution. For each species, I cite the original description as well as most others published since Barretto's 1947 catalog. In cases where a species was reviewed subsequent to 1946 (e.g. Forattini, 1973), I refer to that publication for full references.

Abbreviations of words used in the text which may not be familiar to some readers are given below:

#### Institutions

USNM --- United States National Museum (Nat. Hist.), Washington, D.C.  
INPES -- Instituto Nacional para Programas Especiales de Salud, Bogota  
INPA -- Instituto Nacional de Pesquisas de Amazonia, Manaus  
UV -- Universidad del Valle, Cali

GML -- Gorgas Memorial Laboratory, Panama

UF -- University of Florida

Collectors

C.H.P. -- Charles H. Porter

C.J.M. -- Cornelius J. Marinkelle

R.C.W. -- Richard C. Wilkerson

D.G.Y. -- David G. Young

Other Abbreviations

ca.-- about

cf.-- compared to

classif. -- classification

descr. -- description

dist. -- distribution

morphol. -- morphology

pop. -- population

Key to the Subfamilies of Psychodidae of the New World

1. Wing venation with 4 branched radius,  $R_{2+3}$  fused into a single vein (Fig. 2B). . . . . 2
- Wing venation with 5 branched radius (Fig. 12G) . . . . . 3
2. Wing venation with short cubitus (cu). Mandibles present . . . . . Sycoracinae (Fig. 2)
- Wing venation with long cubitus. Mandibles absent. . . .Trichomyiinae

3. Palpus of 4 segments, rarely 3. Eyes usually with eye bridge.

Antennal flagellomeres nodiform or barrel shaped. . . . . Psychodinae

Palpus of 5 segments. Eyes without eye bridge. Antennal flagel-

lomeres subcylindrical. . . . . 4

4. Females with 1 spermatheca. Mandibles absent. Male aedeagus

entire. . . . . Bruchomyiinae

Females with 2 spermathecae. Mandibles present. Males with bifid

aedeagus. . . . . Phlebotominae (Fig. 12F)



## GENERAL MORPHOLOGY AND TERMINOLOGY

This brief discussion focuses on the structures commonly used in taxonomic studies of phlebotomine sand flies. General accounts of adult anatomy include those by Fairchild and Hertig (1947a), Kirk & Lewis (1951), Abonnenc & Minter (1965), Davis (1967), Abonnenc (1972), Lewis (1973), and Forattini (1973). The terminology varies according to author; that used here applies also to the sycoracine flies except where otherwise stated.

Although little studied, the immature stages are probably no less important in systematics; they are not considered here owing to lack of material. For information on the anatomy of these stages see Barretto (1941), Hanson (1968), Abonnenc (1972), Carneiro & Sherlock (1964), Ward (1977), and Zimmerman et al. (1977). Descriptions of immatures of those species occurring in Colombia are cited in the appropriate species bibliography.

The sand fly head and its appendages (Fig. 12A) are useful in associating conspecific males and females and for grouping taxa below the genus level. Head height, measured from the vertex to the tip of the clypeus, in relation to its greatest width is of value in distinguishing some of the *Lutzomyia* species.

As a probable adaptive feature related to host finding, the size of the compound eyes varies according to species, especially those of *Lutzomyia*, but may be characteristic of subgenera and equivalent species

groups. Contrary to Davis (1967), ocelli are lacking in the Phlebotomines and Sycoracines. Illustrations are by far the best way to indicate eye size, the relative terms such as "small" or "large" being understood easily with associated figures. The interocular distance or eye separation is the narrowest distance between the eyes and is measured directly or may be expressed by the number of facet diameters (or fractions thereof) needed to connect the eyes.

The interocular suture (= post frontal suture of mosquitoes, Christophers, 1960) is complete in adults of *Brumptomyia* (Fig. 8B), *Wariileya* (Fig. 6A), and *Sycorax* (Fig. 2A) but is incomplete in those of *Lutzomyia* (Fig. 12A).

In Phlebotominae, the maxillary palpus (Fig. 12A) consists of 5 segments, the basal one (palp 1) always the smallest and least important in taxonomy (Lewis, 1973). Being partially fused with the second, it is difficult to accurately measure. The relative lengths of the segments are expressed often by a palp formula or by ratios with palp 1 being unity or 10 (Kirk & Lewis, 1951). A palp formula of 1-4-2-3-5 indicates that palp 1 is the shortest, palp 4 the next shortest, etc. When two segments are equal in length they are enclosed in brackets, e.g. 1-(4-2)-3-5. The sycoracines have four, instead of five, palpal segments (Fig. 2E).

Species in both subfamilies have palpal sensilla (= Newstead's scales) which are small clubbed sensory organs attached to one or more segments in the phlebotomines and to palp 2 in the Colombian *Sycorax* spp.

The cylindrical antennal flagellomeres, unlike true segments, are not independently muscled (Imms, 1938). For this reason I join the increasing number of students who use the term "flagellomere" in the place of "antennal segment." The antenna consists of a scape, pedicel,

and 14 flagellomeres, each of which is designated by a Roman numeral (Fig. 12A). In *Sycorax* the terminal flagellomere is markedly reduced in size (Fig. 2D). The length of flagellomere 1 (= antennal segment 3), the most basal flagellomere, in relation to other flagellomeres, head height, or labrum length is useful as a diagnostic feature at the species or subspecies level.

The paired antennal ascoids (Fig. 12B), often difficult to observe, are important owing to interspecific variation in their distribution, shape, and length. Some specimens may have but a single ascoid on a particular flagellomere.

The mouthparts of New World phlebotomines in relation to feeding habits and taxonomy were studied in detail by Lewis (1975a). Following him, I use the term labrum for the labrum-epipharynx of various authors. Its length is measured from the apex of clypeus to tip of proboscis.

The cibarium (= buccal cavity) lies within the clypeus and is armed with a variable number of teeth in the *Lutzomyia* and *Brumptomyia* females. Those in the latter genus are characteristically arranged in 4 longitudinal rows (Fig. 10M). Cibarial teeth are absent in both sexes of *Warileya* and *Sycorax* and are poorly developed or absent in the *Lutzomyia* and *Brumptomyia* males.

When viewed ventrally as in Fig. 12E, the horizontal teeth (= hind teeth) of most *Lutzomyia* females indeed look like teeth, their tips pointed, or not, depending on species. The vertical teeth (= fore teeth) usually appear as dark dots distad of the horizontal teeth at the same angle of view (Fig. 12E). Lateral teeth may occur on both sides of cibarium near the horizontal teeth (Fig. 30M). The number, position, shape, and size of these cibarial teeth are very important in species diagnosis and classification.

Two other features of the cibarium are noted in the descriptions and keys. The chitinous arch (Fig. 12E), when complete, crosses the ventral wall of the cibarium. Its development varies according to species and may be complete or not. The pigment patch on the dorsum of cibarium (Fig. 12E) varies in size, shape, and degree of infuscation (= pigmentation) in the *Lutzomyia* spp.

The pharynx (Fig. 12C), composed of 3 chitinous plates, is attached to the cibarium. Many species of Old World phlebotomines (genus *Sergentomyia*) have spines on the posterior part of the pharynx but they are relatively rare in the *Lutzomyia* spp., occurring mostly in some species in the *cayennensis* and *oswaldoi* groups. The majority of *Lutzomyia* females have transverse, unarmed ridges on the wider, posterior area of the pharynx. The length of the pharynx is given in descriptions although it is flexible and difficult to measure with accuracy (Lewis, 1967a).

I adopt the terminology of Davis (1957) as applied to the thorax. The mesonotum should correctly include the mesoscutum, mesoscutellum, and postnotum and should not be restricted to the mesoscutum alone (Saether, 1971).

The degree and distribution of pigmentation of the thorax and other body regions are important in associating sexes and for distinguishing species of *Lutzomyia*. Coloration has not been given much importance in systematic works but I find it generally dependable as a taxonomic character as applied to the New World phlebotomines.

Pleural setae on the anepisternum (upper episternal setae) and katepisternum (lower episternal setae) are present in species of *Lutzomyia*, *Brumptomyia*, and *Sycorax*. The *Warileya* spp. and the majority of Old World phlebotomines lack such setae (Abonnenc & Leger, 1975). Additional

pleural setae, not mentioned in other studies to my knowledge, occur behind the metathoracic spiracle in all species of Phlebotominae and Sycoracinae examined, those in the latter subfamily being 4 in number and relatively stout (Fig. 2H). The 4 postspiracular setae in the phlebotomine species are reduced in size, barely visible (Fig. 12D).

The wing length is measured from the basal costal node (= rudiment of tegula; Snodgrass, 1935) to its apex; its width at widest part (Fig. 12C). Certain wing vein sections (Fig. 12C) are given useful, easily remembered names. *Alpha* ( $\alpha$ ) is the length of  $R_2$  from its junction with  $R_3$  to the costa. *Beta* ( $\beta$ ) is the length of R from the junction of  $R_4$  to the junction of  $R_2 + R_3$ . *Gamma* ( $\gamma$ ) is the section of R from the r - m crossvein to the junction of  $R_5$ . *Delta* ( $\delta$ ) is that part of  $R_1$  distad of the junction of  $R_2$  and  $R_3$ . It is negative when  $R_1$  ends before this junction.

The legs are measured as in Fig. 12H. A few phlebotomine spp. have a row of short spines on the hind femur (Fig. 31F). The length of the femur in relation to that of the tibia and/or basitarsus is sometimes used for distinguishing species of *Lutzomyia*.

The setation of the abdominal tergites 2 and 6 is useful in the classification of Old World phlebotomines but has been little studied for the New World species. Lewis (1975b), however, discussed and figured the socket patterns for some species, noting that the patterns were of 5 types. Setae on the sides of tergite 8 may be present or not in New World females of Phlebotominae and Sycoracinae.

The nature of the abdominal sternites, especially sternites 2 and 3, is useful in associating male and female sand flies (Hertig & Fairchild, 1950) but the character state is variable among individuals of conspecific populations (Forattini, 1954).

The structures of the bilaterally symmetrical male genitalia, labelled in Fig. 2 and 12, are extremely important in systematics. After eclosion, the genitalia rotates  $180^\circ$  in the phlebotomine males but not in those of *Sycorax*. The style, attached to the apex of the coxite, bears 1 to 6 major spines\* and 0 to many additional small setae. The presence of numerous strong spines is presumably a plesiomorphic feature (Theodor, 1965).

The coxite is the dorsal basal appendage in the phlebotomine males and, of course, is the ventral basal one in the *Sycorax* males. It may or may not have a setal tuft or other nondeciduous setae on its inner surface. These setae are those which remain on the coxite after maceration and which usually differ in size or shape from other setae on the appendage.

The fused, paired aedeagi, each of which is called the aedeagus is subtriangular and well sclerotized in most phlebotomine males. Some species (e.g. *L. walkeri*) have aedeagi with dorsal projections. The aedeagus of the Colombian *Sycorax* males is complex as in Fig. 2F. There is a basal, laterally flattened sperm pump within the abdomen, distal paired genital filaments and other structures mentioned on p. 31. The genital pump of the phlebotomine males is probably homologous with the sperm pump of the *Sycorax* spp. Leading from it are 2 genital filaments which pass through each aedeagus and which vary in length, width, and sclerotization according to species. The apices are simple, modified, inflated or not.

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\*It is difficult to define major (= strong) spine, as it is a relative term referring here to size. One author's interpretation may differ from that of another. In doubtful cases, the illustrations should be studied to understand the meaning of statements in the text.

The phlebotomine parameres lie between the coxites and ventral lateral lobes when viewed laterally. Their shape and setation are important in differentiating species. Simple parameres, i.e., those without arms or processes, are shown in Fig. 16F and 18A. Complex parameres are illustrated in Fig. 44H. The cercopods of the *Sycorax* males appear to correspond to the parameres of Phlebotominae and are very complex.

The ventral, nonsegmented lateral lobes are more or less uniform in the phlebotomine males, although their length, width, and setation may offer good characters in some species. Corresponding structures are wanting in the sycoracines.

The shape of the setose cerci may help associate conspecific sexes but in general these structures are of limited use in species diagnosis.

The size and structure of the internal paired spermathecae and their ducts (Fig. 12F) are particularly important in the classification and identification of female sand flies. An idea of the variety of spermathecae can be gained by scanning the illustrations in this review. A well sclerotized, "Y" shaped genital fork or furca in the phlebotomines is associated with the spermathecae.

## METHODS AND MATERIALS

### Field Collections

For sampling phlebotomine and sycoracine populations, several methods should be used to determine species diversity and relative abundance. In Choco Department and elsewhere to a lesser extent, we used the following methods to capture these flies.

*Battery powered light traps* (Sudia and Chamberlain, 1962) attract many psychodids, the numbers varying according to weather conditions, location, species composition, etc. We secured these traps to tree branches 2 meters above ground level but did not use carbon dioxide as an adjunct attraction. At Curiche, where at least 1 trap per week was operated throughout the night (1800 hrs.-0700 hrs.), we collected a total of 23 phlebotomine spp. (378♂♂, 789♀♀) from April to Dec., 1967 (39 trap nights). We recorded 36 sand fly species from Curiche based on all collection techniques.

*Shannon traps* (Shannon, 1939) made from muslin bedsheets do not trap insects *per se* but are collecting devices similar to those used by lepidopterists in "sheeting" for moths at night. A gasoline lantern provides a light source enabling collectors to readily aspirate the psychodids which land on the illuminated cloth. They are attracted to the light, to the collectors, or to a combination of both. The species composition of light and Shannon trap captures is generally similar.



*Malaise traps* (Townes, 1962) and *flight traps* (similar to the design of Gressitt and Gressitt, 1962) were placed in forest clearings, across trails or other flyways at ground level and in the forest canopy. Insects which land on the trap baffles eventually die after making their way upwards to the killing jar(s) charged with potassium cyanide. Ordinarily, these traps do not capture large numbers of psychodids but they are effective in sampling the species composition of a given area if operated over extended periods of time. For example, in the Curiche Forest at ground level, one Malaise trap captured 24 Phlebotomine species (316♂♂, 482♀♀) from 3 April 1967, to 30 Nov. 1967 (109 trap days<sup>\*</sup>).

Whenever possible, we searched diurnal resting sites for sand flies. These included tree trunks, especially dark crevices between buttresses, animal burrows, and litter on the forest floor. Tree trunks are favored resting sites for several species, specimens of which are easily captured with a simple aspirator.

During the survey in Choco Dept., especially at Curiche and Teresita, we collected large numbers of phlebotomines on human bait. The majority of collections were made by 2 men sitting on the forest floor between 1830 and 2100 hours. Phlebotomines were captured with aspirators as they attempted to feed, the results computed on a man-hour basis, i.e., the total number captured in one hour divided by the number of collectors.

Specimens were preserved dry in cardboard pill boxes rather than in alcohol to prevent hardening of muscle tissue.

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\*One trap day equals 24 hours.

### Laboratory Methods

For routine identification of phlebotomines and sycoracines, undissected specimens are first macerated (i.e., cleared) in 10-20% NaOH. The loss of pigmentation can be reduced by heating this solution (containing the flies) to the boiling point rather than macerating them at room temperature for 12 hours or more. The flies should be left in the hot NaOH for 5 minutes, then placed directly into a drop of 80-95% liquid phenol ( $C_6H_5OH$ ) in a depression microslide. Within 5 minutes, the important internal structures such as the spermathecae and ducts are clearly visible and should be drawn if necessary. Once identified, the flies can be discarded, preserved in vials of 70% alcohol, or processed further for slide mounting. I follow the procedure of Fairchild and Hertig (1948c) except that Canada balsam or Euparal is substituted for copal.

Other slide-mounting procedures are discussed by Osorno et al. (1966), Quate & Steffan (1966), and Lewis (1973) and others. The choice of which to use is a matter of personal preference but in all cases the best preparations are made from freshly killed flies.

Sometimes it is necessary to remount specimens because of undesirable position and/or shrinkage. For those embedded in Canada balsam or other xylene-soluble media, it is advisable to submerge the entire slide in liquid phenol in a suitably closed container such as a petri dish. After 3 to 7 days, the specimens become soft and are easily handled. Xylene as a solvent should be avoided as the specimens tend to become brittle and easily damaged.

Specimens were drawn with the aid of a camera lucida and Bausch and Lomb microprojector. I measured specimens with a calibrated ocular micrometer. All such measurements are given in millimeters throughout the text and figures.

DISTRIBUTION, COLLECTING LOCALITIES, AND  
CHARACTERISTICS OF THE FAUNA

The distribution of phlebotomines and sycoracines can be understood by present ecological factors, both biotic and physical, and by knowledge of past changes in climate, vegetation, and geology. Haffer (1967, 1974) discussed the probable speciation and distribution of some neotropical birds in relation to past changes, especially those occurring in the Pleistocene and post Pleistocene periods. During times of drought, populations of forest birds and other organisms were restricted to isolated forest refugia which acted as core areas of speciation. As conditions became wetter, these forests enlarged in area, often merging with others to form zones of secondary contact. The presumed forest refugia in Colombia and elsewhere were discussed and mapped by Haffer (1967, 1974) and Brown (1975), the latter author studying speciation in forest butterflies in relation to these presumed refugia.

Although more data are needed, the refuge theory offers a plausible explanation for understanding recent speciation in the Phlebotominae and Sycoracinae. The majority of New World species inhabit forests, especially those in the lowland tropics which receive 2000+ mm of rain per year.

For discussion purposes, it is convenient to divide Colombia into natural regions. D'Allesandro & Barreto (1971) delineate 7 such areas, their large "Oriental Region" consisting of both Amazonian forest and eastern natural savannah (llanos). Within each region there are one or more life zones, each defined by a combination of biotemperature, annual

precipitation, humidity, and vegetation (Holdridge, 1967). The life zones in Colombia were studied by Espinal and Montenegro (1963). Their "bosque humedo" translates to "tropical moist forest" (2000-4000 mm of rain per year) and "bosque muy humedo" corresponds to "tropical wet forest" (4000-8000 mm of rain per year). The "bosque pluvial" (= "tropical rain forest"), the wettest lowland life zone, receives over 8000 mm of rain per year.

Figure 1 depicts where phlebotomines and sycoracines have been collected in Colombia. Osorno et al. (1972a) provide specific data for most localities; others from which collections were made by me or my colleagues are discussed below in relation to faunal regions (D'Allesandro & Barreto, 1971) and distribution centers (Haffer, 1974).

#### Pacific Coast Region

Haffer (1967) attributes the "high concentration of endemic species in the tropical lowland forests of western Colombia and Central America" to a gradual accumulation of isolates in the *trans*-Andean forest region.\* The dominant refugium on the Colombian Pacific coast is the Choco refugium extending from Lago Calima (Valle) to north of Quibdo (Choco) and across the Rio Atrato and San Juan river systems (Brown, 1975).

An analysis of the phlebotomine species and subspecies inhabiting the Pacific coast region indicates the following.

The vast majority of the 41 known taxa, probably originated in forests east of the Andes (*cis*-Andean region). Most of these reached the

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\*The *trans*-Andean region comprises "Middle America and the narrow Pacific lowlands along the western base of the Andes" (Haffer, 1967). *Cis*-Andean refers to lowland forests east of the Andes.

Pacific coast forests by advancing around, not across, the northern Andes.

These species which now occur on both sides of the mountains include:

*Lutzomyia ayrozai*, *L. guyanensis*, *L. hispinosa*, *L. gomezi*, *L. nordestina*, *L. serrana*, *L. pilosa*, *L. spinosa*, *L. trinidadensis*, *L. shannoni*, *L. tuberculata*, *L. trivittata*, and others.

Nine of the 41 species and subspecies do not occur in other regions of the Republic. Of these, only *Lutzomyia* sp. of Anchicaya is precinctive, the others occurring also in the *trans*-Andean regions of Northwestern Ecuador and/or Central America. These species include: *Braueromyia* *hirsuta*, *Warileya nigrosacculus*, *L. reburra*, *L. recurva*, *L. isovespertilionis*, *L. yllephiletor*, *L. sanguinaria*, and possibly *L. odax*. Two forms which probably evolved in Pleistocene forest refugia within the *trans*-Andean region include *L. carrerai thula* n.spp. and *L. barrettoi majuscula* n.spp., both of which now occur in *trans*-Andean regions of Ecuador, Colombia, and Central America and east to the northern foothills of the Central Cordillera of the Colombian Andes.

There is a slight possibility that some phlebotomines were able to cross the Andes in southern Ecuador and northern Peru in times past when wet forests occupied the now dry valleys. Some Amazonian birds apparently colonized Pacific coast forests in such a manner (Haffer, 1967). Phlebotomines, however, are rather weak fliers and it would have been necessary for lowland forms to survive at elevations above 2000 meters above sea level. The one possible example of successful colonization may be that of *L. reburra* -- a species whose closest allies occur entirely in the *cis*-Andean region, especially in Amazonian forests.

A few species such as *L. vespertilionis* and its sister species, *L. isovespertilionis* probably invaded the Pacific coast region of Colombia

from Central America, the former species also occurring east of the Andes, at least as far south as Bolivar Department.

#### Department of Choco

Three collecting sites within this Department were described by Eldridge & Fairchild (1973) and Eldridge et al. (1973). Maps accompany their descriptions.

*Curiche*. On narrow coastal plain between western slopes of Serrania del Baudo and Humboldt Bay on the Pacific coast; "tropical wet forest;" elevation\* less than 10 m. Sand flies were collected from April 1967, to Dec. 1967, in disturbed and undisturbed evergreen forests and near a mangrove swamp.

*Alto Curiche*. About 3 km inland from Curiche on western ridge of Serrania del Baudo; "tropical wet forest;" elevation 302 m. The sand fly fauna is similar to that of nearby Curiche.

*Teresita*. At eastern foothills of Serrania de Baudo, near Rio Truando; transitional life zone, "tropical moist/tropical wet forest;" elevation 35 m. Collections made in semi-disturbed forests on flat or gently rolling terrain from March-Dec. 1967.

#### Department of Valle

*Anchicaya Dam*. About 35 km inland from Pacific Ocean, on the Rio Anchicaya; "tropical wet forest;" elevation ca. 560 m. This site is similar to that near the Rio Anori (Antioquia Dept.) in terrain, elevation,

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\*Elevation is expressed here and elsewhere in meters above sea level.

and climate. Sycoracines were recorded from both localities and from one other in Cauca Department.

25 km E of Buenaventura. "Tropical rain forest" according to Espinal (1968); elevation ca. 50 m. Phlebotomines were captured in a patch of disturbed forest surrounded by cultivated fields.

#### Atlantic Coast Region

This area encompasses not only the Caribbean lowlands but also the northern foothills of the western and central Cordilleras of the Andes. The presumed Nechi refugium is located here, a center "heavily influenced by the Choco center to the west" (Haffer, 1967). The present life zones are more diverse here than in the Pacific coast forests and except for the area near the Rio Anori, the phlebotomine fauna has been little studied.

Intensive collections of phlebotomines made by Dr. C.H. Porter and his colleagues near the Rio Anori (1970-1971) yielded 37 species and subspecies. Thirty of these also occur in Pacific coast forests, a fact not surprising based on the distribution of other organisms (Haffer, 1967, 1974). *Lutzomyia strictivilla* may be endemic. *Lutzomyia yuilli* and *L. nocticola* are cis-Andean taxa. The former reaches its northernmost limits in northern Colombia; whereas *L. nocticola* invaded extreme western Panama but populations between there and northern Colombia have since disappeared.

#### Department of Antioquia

Rio Anori (7° 19'N; 75° 04'W), about 24 km SW of Zaragoza; "tropical wet forest;" elevations from 500-700 m. Located in the foothills of the



central Cordillera of the Andes, this site is mostly well forested with steep, well drained slopes. A detailed description is given by Porter & Defoliart (MS).

#### Department of Magdalena

Three sites near Santa Marta yielded sand flies from tree trunks or under loose bark of standing trees in cultivated or semicleared areas (August, 1973).

*Rio Don Diego*, E of Santa Marta within 1 km of Caribbean Sea; "tropical wet forest;" elevation ca. 3 m.

*Between Santa Marta and Minca*, near a small stream; probably a transition zone between "tropical wet forest" and "tropical dry forest;" elevation ca. 80 m.

*Minca*, SE of Santa Marta; life zone indeterminate but similar to preceding site; elevation 200 m.

#### Andean Region

Nearly all records of phlebotomine species occurring above 1000 m are given by Osorno et al. (1972a). Based on these and on my limited collections from the Western Cordillera, it is apparent that the *Lutzomyia* species in the *verrucarum* and *venator* groups dominate the rather depauperate phlebotomine fauna.

#### Department of Valle

Three sites W or SW of Cali -- 1. Near *Pichinde*, 2. In forest at the television tower just E of Salidito, and 3. Near *Rio Punce*, SW of Cali;

"lower montane very wet forest;" elevations from 1570-1700 m. Limited collections from 31 July, 1973, to August, 1973.

Department of Cauca

Eastern slope, near summit of Cerro Munchique, west of Popoyan;  
"lower montane rain forest;" elevation ca. 2500 m. Briefly surveyed on  
5-6 August, 1973. One *Sycorax* sp. taken but no phlebotomines.

Oriental Region

Occupying a huge area east of the Andes, the Amazonian forest in Colombia is apparently rich in phlebotomine species but few collections have been made there or in the more northern Llanos which forms part of the Oriental Region (Haffer, 1967, fig. 1). Many of the species known from the Amazonian forests in Brazil, Peru, and Ecuador are expected to occur also in Colombia.

Comisaria of Amazonas

About 17 km W of *Leticia*; "tropical moist forest;" elevation 84 m. Phlebotomine flies were relatively rare in late July, 1973, the bulk of the material being taken in semi-disturbed forests near the Amazon River on tree trunks, less commonly in light traps. July and August are the two driest months at this locality.

Intendencia of Caqueta

*Tres Esquinas*; transitional life zone, "tropical moist forest"/  
"tropical wet forest;" elevation ca. 200 m. Using light traps, Dr. C.J.  
Marinkelle collected numerous phlebotomines in November, 1971.

Figure 1

Map of Colombia showing localities where phlebotomines and sycoracine flies have been collected (records based on Osorno et al., 1972a and this review). Shaded sections represent areas 1000 m+ above sea level.

Legend

- = Phlebotomine record
- X = Sycoracine record
- ⬢ = Phlebotomine and sycoracine record
- 1 = Atlantico Dept.
- 2 = Magdalena Dept.
- 3 = Norte de Santander Dept.
- 4 = Caldas Dept.
- 5 = Risaralda Dept.
- 6 = Quindio Dept.
- 7 = Cundinamarca Dept.



## MEDICAL IMPORTANCE

The phlebotomine sand flies, unlike the sycoracine flies, are notorious vectors of leishmaniasis (Ward, 1977), bartonellosis (Schultz, 1968), and certain arboviruses (Tesh et al., 1974), diseases which have caused a great deal of human suffering in the neotropics and elsewhere.

Leishmaniasis, a collective term referring to several disease entities caused by *Leishmania* spp., occurs in Colombia but the vectors are poorly known. Reyes (1957) provided limited information on the distribution and nature of dermal (= cutaneous) leishmaniasis in the Republic, noting that 206 out of 725 human infections involved the naso-pharyngeal region (mucocutaneous leishmaniasis). Ward, citing figures from Reyes (op. cit.) and Garnham (1962), stated that nearly 2000 human cases of cutaneous leishmaniasis were reported in Colombia from 1948 to 1955. The true incidence, distribution, and identity of leishmaniasis in the Republic remains largely unknown, however.

Visceral leishmaniasis (kala-azar), a very serious disease, is apparently rare in Colombia, the few human cases from Santander, Tolima, and Cundinamarca Departments having been discussed by Arjona et al. (1971).

An outbreak of Bartonellosis (oroya fever, Carrion's disease, etc.), lasting from 1935 to the early 1940's, in southwestern Colombia (Cauca and Narino), was reviewed by Jaramillo (1943). From 1940 to 1943, there

were 2,241 cases with a mortality rate of nearly 16% (Samaniego, 1944). The disease, also known to occur in Peru and Ecuador, was probably introduced into Colombia "by returning soldiers or by 'colporteurs' who travel from village to village" (Rozeboom, 1947b). Circumstantial evidence led investigators to believe that *Lutzomyia columbiana* was the responsible vector.

Arboviruses were recovered from wild caught phlebotomines in the Pacific lowlands of Colombia (Barreto, 1969). The strain, designated Co Ar 3319, was discussed by Theiler and Downs (1973) and Tesh et al. (1974). Based upon the pioneering work of Dr. Tesh and his colleagues in nearby Panama (1971-1975), it is safe to assume that other arboviruses associated with phlebotomines exist in Colombia.

Sand flies also play a role in the transmission of nonhuman parasites, especially protozoans. References to studies related to them are cited in the species bibliographies.

#### SUBFAMILY SYCORACINAE

Following Duckhouse (1972) I presently recognize 3 extant genera in the subfamily -- *Sycorax* Haliday (ca. 21 spp.), *Parasycorax* Duckhouse (2 spp.), and *Aposycorax* Duckhouse (1 sp.). Until now, only 4 species have been reported from the New World -- *Sycorax assimilis* Barretto, 1956 and *Parasycorax satchelli* (Barretto, 1956) from Sao Paulo State, Brazil, *Aposycorax chilensis* (Tonnoir, 1929) from Chile, and an unnamed sycoracine, the wing of which was figured by Fairchild (1955) from Palenque, Colon Prov., Panama.

The feeding habits of most species have not been studied but the females of *Sycorax* and *Aposycorax* at least possess mouthparts adapted for sucking blood. *Sycorax silacea* Curtis, the type species of the genus from Europe, feeds on frogs and transmits a filarial worm to them (Desportes, 1942).

The four new Colombian species, described here in the genus *Sycorax*, share several characters which set them apart from the other sycoracine species. In addition to the paired genital filaments between the parameres (= cercopods) of the male genitalia, there is a single median process which seems to form part of the aedeagal complex. It lies above the ducts and the proximal sperm pump (Fig. 2G). *Aposycorax chilensis*, the only sycoracine with inverted male genitalia (Duckhouse, 1972), has very long genital filaments but it lacks the elongate median process. The stout proximal spines (2 or 3) on each style of the Colombian and



*Parasykorax* species distinguish them from the extant species in the subfamily.

Other features, not always repeated in the specific descriptions which follow, are shared by the 4 Colombian *Sycorax* species. *Coloration*: Dusky brown, mesonotum but slightly darker than pleuron. *Head*: Broader than long; frons puffed out behind antenna. Palpus of 4 segments, the second with an inner group of 10-20 sensory rods. Antenna slender, of 16 "segments" (scape, pedicel, and 14 flagellomeres), the last reduced in size and terminating in a cone shaped peg sensilla (two similar sensilla on flagellomere XIV); outer base of scape with 2 short sensory hairs as in *A. chilensis*; pedicel with 2-3 similar hairs; ascoids subequal in size, often difficult to examine in available material. Female mouthparts include toothed mandibles and 4 boot shaped sensilla at tip of labrum; these features absent in males. Cibarium unarmed. *Thorax*: Pleura with 6+ setae mainly on the anepimeron but some may extend downwards to the katepimeron; upper episternal setae present or not; both sexes with 4 straight bristles below base of haltere (Fig. 2H). Wing broadly rounded; veins sparsely haired; radial fork distad of medial fork. *Abdomen*: Females without setae on tergites 8 and 10 or sternite 8. Male genitalia not inverted. Style with a patch of 8-15 short pointed setae at base; terminal spine slightly beveled at tip, 2 or 3 proximal spines present, with or without a long subterminal hair; aedeagal complex as mentioned above; the paired genital filaments turned upwards, sinuous or not; parameres somewhat resembling those of *A. chilensis* but differing in the nature and position of the lobes, setae, and projections. Female genitalia: Each spermatheca and sperm duct forming a continuous tube with faint transverse striations, terminating in a heavily sclerotized "button"

which appears shiny black; a tenuous sac usually amorphic following treatment in KOH, arises from the end of the button; an internal apodeme or furca associated with paired spermathecae.

The combined length of the spermatheca and duct varies interspecifically and probably corresponds to the length of the male genital filaments. This feature and the distribution of the antennal setae and distance between the compound eyes were also used in associating the sexes of three of the Colombian species but there remains the possibility that the males and females were not correctly associated. The immature stages of these and other New World species in the subfamily have not been discovered.

Keys to the *Syconax* Species

Males

1. Style of male genitalia with 3 strong spines and long subterminal hair; median process of aedeagus parallel-sided in dorsal view; lower distal projection of paramere pointed at tip. Antennal sensory setae, excluding the paired ascoids, arranged in a whorl-like pattern on flagellomeres. . . . . 2
- Style with 3-4 strong spines but without long subterminal hair; median process of aedeagus with basal two-thirds expanded and terminal one-third slender in dorsal view; lower distal projection of paramere rounded at tip. Antennal sensory setae, excluding the paired ascoids, not arranged in a whorl-like pattern. . . . . 3

2. Aedeagal ducts relatively long, exceeding the length of the sperm pump. A subtriangular plate, dorsoventrally flattened, with acute bifurcate tip present below the base of the median process of aedeagus. Tip of median process of aedeagus rounded in lateral view  
..... *colombiensis* (Fig. 3)
- Aedeagal ducts shorter, less than length of sperm pump and not as sinuous. Subtriangular plate absent. Tip of median process of aedeagus angular in lateral view. .... *fairchildi* (Fig. 4)
3. Style of male genitalia with 4 strong spines; median process of aedeagus more slender (Fig. 2G). A larger species, wing length greater than 2 mm ..... *andicola* (Fig. 2)
- Style with 3 strong spines; median process of aedeagus relatively stout (Fig. 5I). Wing length less than 1.5 mm. . *trispinosa* (Fig. 5)

#### Females

1. Flagellomeres I-VIII with paired ascoids, other antennal setae randomly distributed. Eyes rather narrow, separated by distance = to 7 facet diameters ..... *trispinosa* (Fig. 5)
- Flagellomeres I-IV with paired ascoids, one group of antennal setae arranged in whorl-like pattern. Eyes separated by 8 or more facet diameters ..... 2

2. Furca spade-shaped apically, its length at least  $\frac{1}{2}$  that of sperm duct + spermatheca. Flagellomere, I, 0.20 mm, or longer . . . . .  
 . . . . . *colombiensis* (Fig. 3)

Furca "v" shaped apically, its length but slightly less than that of sperm duct + spermatheca. Flagellomere I less than 0.20 mm long  
 . . . . . *fairchildi* (Fig. 4)

1. *Sycorax andicola* n. sp.  
 (Fig. 2)

*Male* (holotype): Wing length 2.35; width 1.05. Head height 0.31; width, 0.37. Eyes separated by 0.14 or by distance = to 2 facet diameters. Antenna (including scape and pedicel) 1.61 long; flagellomere I (0.26 long), about 1.8 x length of flagellomere II; paired ascoids (Fig. 2C), subequal in size, on flagellomeres I-IV only; other antennal setae mostly deciduous, not arranged in a whorl-like pattern. Palpal length 0.17; ratio of segments: 1-1.02-0.72-0.67; second segment with 20+ strap-like sensory rods in a distinct patch. Pleura with 19-22 setae below wing base, without episternal setae. Wing venation as figured. Length of femora, tibiae, and basitarsi: Foreleg, 0.63, 0.73, 0.49; midleg, 0.63, 0.75, 0.47; hindleg 0.73, 0.82, 0.44. Visible sternites 2 and 3 with paired circular openings laterally. Genitalia complex: Coxite 0.31 long. Style 0.18 long with 1 terminal spine, slightly beveled at tip and with a proximal row of 3 smaller spines. Paramere as shown with several setose lobes and projections, the most distal finger-like with rounded, upturned tips. Aedeagal complex of a laterally compressed sperm pump (0.20 long) within the abdomen; a median distal process (0.165 long) compressed dorso-ventrally, curved and slender in lateral view, upturned at tip, basal

two-thirds much wider than distal one-third when viewed dorsally; paired sinuos, relatively long genital filaments. Cerci as figured.

*Material examined:* Colombia. ♂ holotype (no. 537), Cerro Munchique (Cauca), 2450 m above sea level, light trap in cloud forest, 6 Aug. 1973, B.G.Y. and R.C.W. coll. ♂ paratype (no. 538), same data except collected by R.C.W., 8 Aug. 1975.

*Discussion:* *S. andicola*, the largest *Sycorax* known from Colombia, closely resembles *S. trispinosa* n. sp. in details of the male genitalia, setation of the antenna and in other character states. The two species, apparently allopatric, are separated by the characters given in the key.

2. *Sycorax colombiensis* n. sp.  
(Fig. 3)

*Male* (holotype): Wing length 1.12; width 0.47. Head height 0.21; width 0.25; eyes separated by 0.126 mm or by distance = to 10 facet diameters. Flagellomere I (0.19 mm long), about 2.2 x length of flagellomere II. Paired ascoids visible only on flagellomeres I and II; other sensory hairs in a whorl-like pattern on flagellomeres I-X, the remaining flagellomeres missing. Palpal length 0.10, ratio of segments 1-0.91-0.80-0.72. Pleura with 9-12 setae in one specimen, but lacking in the holotype. Wing venation as figured. Legs missing. Nature of sternites not determinable. Genitalia: Coxite (0.177 long); style (0.98 long) with a terminal spine, a long subterminal bristle and 2 proximal spines. Paramere as figured, the lower distal projection blade-like, pointed at tip. Aedeagal complex: Sperm pump (0.10 long); median distal process (0.09 long), slender and subequal in width in dorsal view, with a slender, rounded tip in lateral view; a subtriangular plate, dorsoventrally

Flattened, with acute bifurcate tip, pointing to the rear, present below the base of the median process of aedeagus. Cerci as shown.

*Female* (allotype): Wing length 1.37; width 0.59. Head height, 0.24; width, 0.29; eyes separated by 0.15 or by distance = to 10 facet diameters. Antenna (1.15 long), flagellomere I (0.22 long), about 2.4 x length of flagellomere II; paired ascoids on flagellomeres I-IV; other sensory hair arranged in a whorl-like pattern on flagellomeres I-XV. Palpal length, 0.113; ratio of segments 1-1-0.75-0.58. Pleura with 16-18 setae below wing base and 0 or 1 upper episternal seta. Wing venation as shown. Legs partly or wholly missing in all specimens, length of femora, tibiae, and basitarsi of foreleg: 0.43, 0.51, 0.27. Abdominal sternite 2 with paired circular openings at sides; other sternites apparently lacking these openings. Spermatheca and sperm duct length at least 0.15 from base to tip of button; furca spade-shaped at end.

*Material examined*: Colombia. ♂ holotype (no. 529), Anchicaya Dam (Valle), elev. ca. 400 m above sea level, light trap, 28 Jan. 1975, R.C.W. ♀ allotype (no. 530), same data as holotype except collected 10 June 1975. *Paratypes* (nos. 531-538), all from type locality in light traps; 1 ♀, 11 Aug. 1973, D.G.Y. and R.C.W. 1 ♂, 2 ♀♀, 28 Jan. 1975; 2 ♀♀, 10 June 1975, R.C.W.

*Discussion*: The male of *S. colombiensis*, the only Colombian species with a flattened subtriangular plate below the base of the median distal process of the aedeagus, was at first confused with *S. fairchildi* but the presence of the plate and the greater length of the aedeagal ducts readily separate the 2 species. The female of *S. colombiensis* share several character states with *S. fairchildi* and *S. trispinosa* but may be identified by the characters in the key.

3. *Sycorax fairchildi* n. sp.  
(Fig. 4)

*Male* (holotype): Wing length, 1.13; width, 0.47. Head height, 0.23; width, 0.28; eyes separated by 0.13 or by distance = to 10 facet diameters. Antenna about 0.79 long; flagellomere I (0.18 long), about 2.5 x length of flagellomere II; paired ascoids visible only on flagellomeres I-III, other sensory hairs in a whorl-like pattern on flagellomeres I-XV, palpal length 0.10 mm; ratio of segments: 1-1.18-1-0.72. Pleura with 5-11 setae below wing base and with 1-2 upper episternal setae (n = 5). Wing venation as shown. Sternites apparently lacking clear circular openings. Length of femora, tibiae, and basitarsi of slide 544: Foreleg, 0.42, 0.43, 0.24; midleg, 0.45, 0.40, 0.24; hindleg, 0.47, 0.37, 0.20. Genitalia: Coxite, 0.16 long; style, 0.88 long, with a large terminal spine, a long subterminal hair and 2 proximal spines. Lower distal end of paramere terminating in a hook-like projection, acute at tip. Aedeagal complex: Sperm pump (0.11 long); median distal process (0.068 long), angular at tip and relatively wide in lateral view, subequal in width when viewed dorsally; aedeagal ducts short, each about 0.96 long. Cerci as shown.

*Female* (allotype): Wing length, 1.47; width 0.61. Head height, 0.26; width, 0.30; eyes separated by 0.14 or by distance = to 9 6 facet diameters. Flagellomere I (0.16 long) about 2.3 x length of flagellomere II; paired ascoids, subequal in size (but not conspicuous) on flagellomeres I-IV, absent from remaining flagellomeres, other nondeciduous antennal setae as in male. Palpal length 0.116; ratio of segments 1-1-0.92-0.78. Pleura with 10-11 setae below wing base and with 1-2 upper episternal setae (n = 3). Wing venation as shown. Length of femora,

tibiae, and basitarsi: Foreleg, 0.39, 0.40, 0.22; midleg, 0.42, 0.47, 0.24; hindleg, 0.47, 0.50, 0.20. Spermatheca + sperm duct length about 0.08 from base to end of subcircular button; furca somewhat "y" shaped apically.

*Material examined:* Colombia. ♂ holotype (no. 539), Anchicaya Dam (Valle), elev. ca. 400 m above sea level, light trap in forest, 11 Aug. 1973, D.G.Y. and R.C.W. ♀ allotype (no. 540), same data except collected 28 Jan. 1975, R.C.W. Paratypes (nos. 541-547) all collected in light traps, 1 ♂, Rio Anori (Antioquia), Colombia, elev. ca. 410 m above sea level, 22 Sept. 1970, D.G.Y. 1 ♂, Rio Anori, 23 Sept. 1970. 1 ♀, Anchicaya Dam, 11 Aug. 1973, D.G.Y. and R.C.W. 3 ♂♂, 1 ♀ Anchicaya Dam, 28 Jan. 1975, R.C.W. 1 ♂, Anchicaya Dam, 5 March 1976, R.C.W.

*Discussion:* The short sperm ducts of *S. fairchildi* serve to distinguish this taxon from the other species of *Sycorax* in Colombia.

I take pleasure in naming the species in honor of Dr. G.B. Fairchild who has contributed so much to our knowledge of medically important arthropods in the neotropics.

4. *Sycorax trispinosa* n. sp.  
(Fig. 5)

*Male* (holotype): Wing length 1.22; width 0.56. Head height 0.23; width 0.28; eyes separated by 0.08 or by distance = to 7 facet diameters. Antenna, 0.88 long; flagellomere I (0.15), about 1.8 x length of flagellomere II. Paired ascoids on flagellomeres I-IV, absent from remaining flagellomeres; other antennal setae mostly deciduous, not arranged in a whorl-like pattern. Palpal length, 0.12 mm; ratio of segments: 1-1.15-0.84-0.76, second segment with 15<sup>±</sup> rod sensilla. Pleura with 9-16 setae



below wing base and 1-4 upper episternal setae ( $n = 10$ ). Wing venation as figured. Length of femora, tibiae, and basitarsi: Foreleg, 0.45, 0.43, 0.26; midleg, 0.49, 0.44, 0.26; hindleg, 0.53, 0.52, 0.24. Abdominal sternites 2-5 with paired lateral openings. Genitalia: Coxite, 0.19 long. Style, 0.09, with 2 proximal spines and a terminal spine. Paramere as shown, similar to that of *S. andicola*, the most distal projection also curved at tip, finger-like. Aedeagal complex of a laterally compressed sperm pump (0.11 long), a median distal process (0.10 long), with the basal two-thirds expanded, greater than twice the width of the terminal third in dorsal view; aedeagal ducts and cerci as shown.

*Female* (allotype): Wing length 1.54; width 0.71. Head height, 0.31; width, 0.27; eyes separated by distance of 0.1 or by distance = to 6.9 facet diameters. Antenna, 1.0 long; flagellomere I (0.16 long), about 1.7  $\times$  length of flagellomere II. Paired ascoids on flagellomeres I-VIII, absent from remaining flagellomeres, other antennal setae mostly deciduous not arranged in a whorl-like pattern. Palpal length 0.14 mm; ratio of segments: 1-0.89-0.61-0.61, palpal sensilla as in male. Pleura with 10-21 setae below wing base and 1-5 upper episternal setae ( $n = 9$ ); wing venation as shown. Length of femora, tibiae, and basitarsi: Foreleg, 0.44, 0.42, 0.27; midleg, 0.49, 0.48, 0.27; hindleg, 0.53, 0.56, 0.27. Abdominal sternites 2-5 with paired circular openings at sides, remaining sternites indeterminate. Combined length of spermatheca and sperm duct, from base to tip of sclerotized button, 0.15. Furca spade-shaped as shown.

*Material examined:* Colombia. ♂ holotype (no. 548), Anchicaya Dam (Valle), elev. ca. 400 m above sea level, light trap in forest, 5 March 1976, R.G.W. ♀ allotype (no. 549), same data. Paratypes (nos. 550-573),

all collected from type locality in light or flight traps by D.G.Y. and/or R.C.W. 2 ♀♀, 10 Aug. 1973; 1 ♂, 1 ♀, 11 Aug. 1973; 13 ♂♂, 4 ♀♀, 28 Jan. 1975; 1 ♂, 2 ♀♀, 5 March 1976.

*Discussion:* I associated the male and female of *S. trispinosa* on the basis of the following characteristics which, in combination, are not shared by *S. fairchildi* or *S. colombiensis*. Flagellomere I relatively short (0.14-0.19 mm, n = 27); compound eyes more narrowly separated than those of the other sympatric species; antennal setae (excluding the paired ascoids) mostly deciduous, scattered; aedeagal ducts and spermathecae generally corresponding in length.

The males of *S. trispinosa* and *S. andicola* are quite similar but differ in size and by other characters given in the key. The female of *andicola*, presently unknown, probably resembles *trispinosa* in details of the spermathecae and palpi.

The specific name refers to the 3 strong spines on the style of the male.

Figure 2

*Sycorax andicola* male -- A. Head, B. Wing, C. Pedicel and flagellomeres I and II showing ascoids, D. Terminal 4 flagellomeres, E. Palpus, F. Genitalia, dorsal view, G. Sperm pump, genital filaments, and median dorsal process of aedeagus, lateral view, H. Metathoracic spiracle and postspiracular setae.

Male: Cerro Munchique, Cauca Dept., Colombia

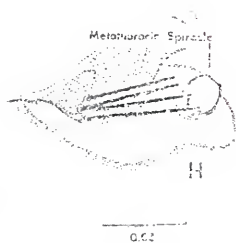
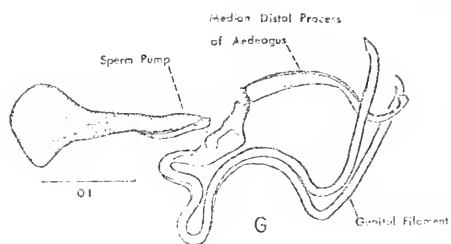
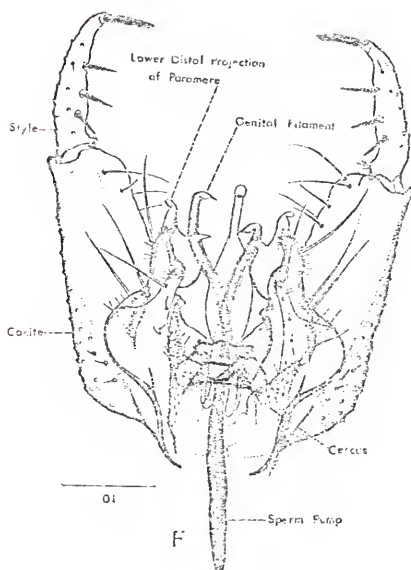
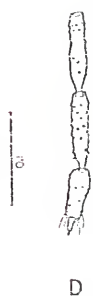
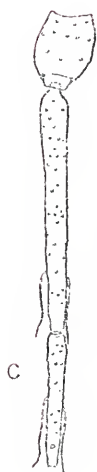
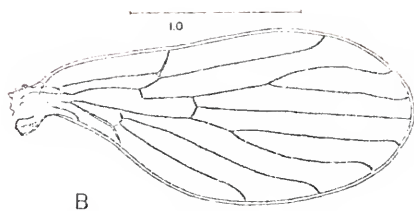
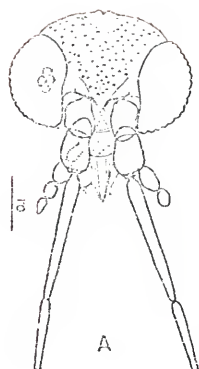


Figure 3

*Sycorax colombiensis* -- A. Male head, B. Female wing, C. Male wing, D. Female head, E. Male genitalia, dorsal view, F. Male subtriangular plate, G. Spermathecae, H. Sperm pump, genital filaments, and median dorsal process of aedeagus, lateral view.

Male: Anchicaya Dam, Valle Dept., Colombia

Female: Same locality as male

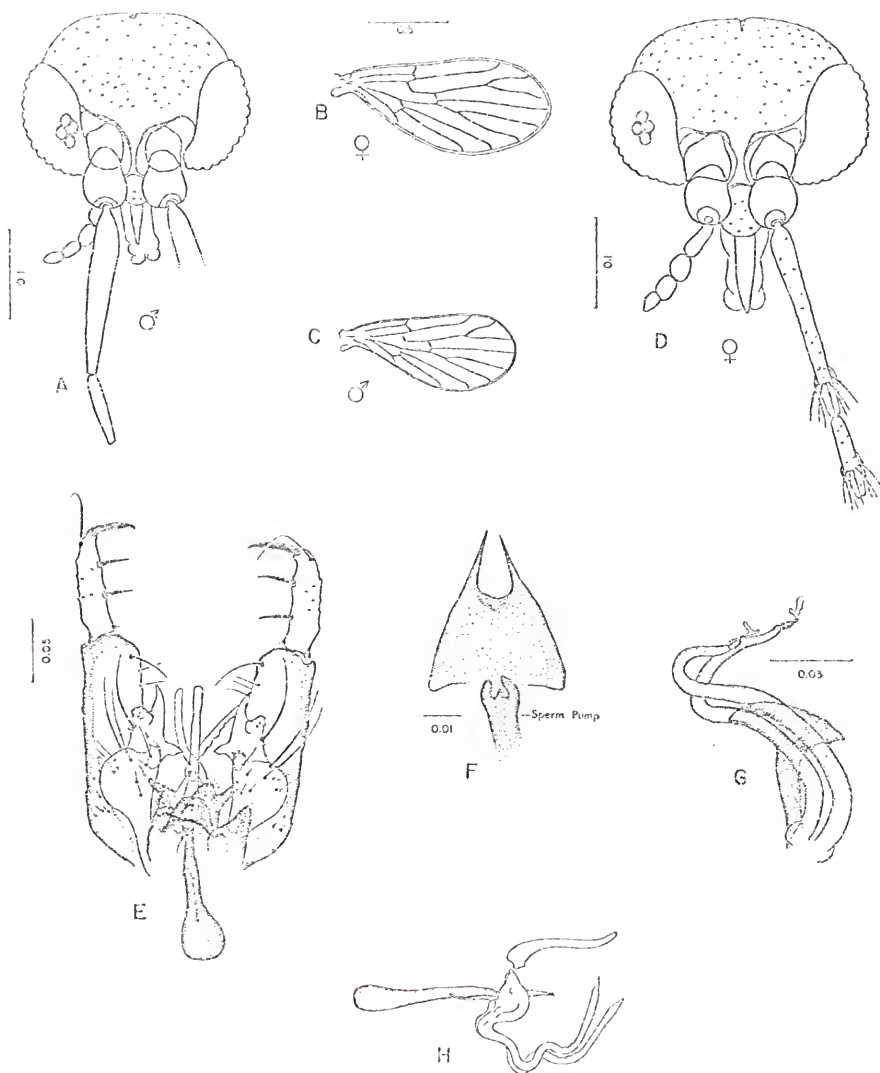


Figure 4

*Syconax fairchildi* -- A. Male head, B. Female wing, C. Male wing, D. Female head, E. Male genitalia, dorsal view, F. Spern pump, genital filaments, and median dorsal process of aedeagus, lateral view, G. Spermathecae, H. Female pedicel and flagellomeres I and II showing paired ascoids and other setae.

Male: Anchicaya Dam, Valle Dept., Colombia

Female: Same locality as male

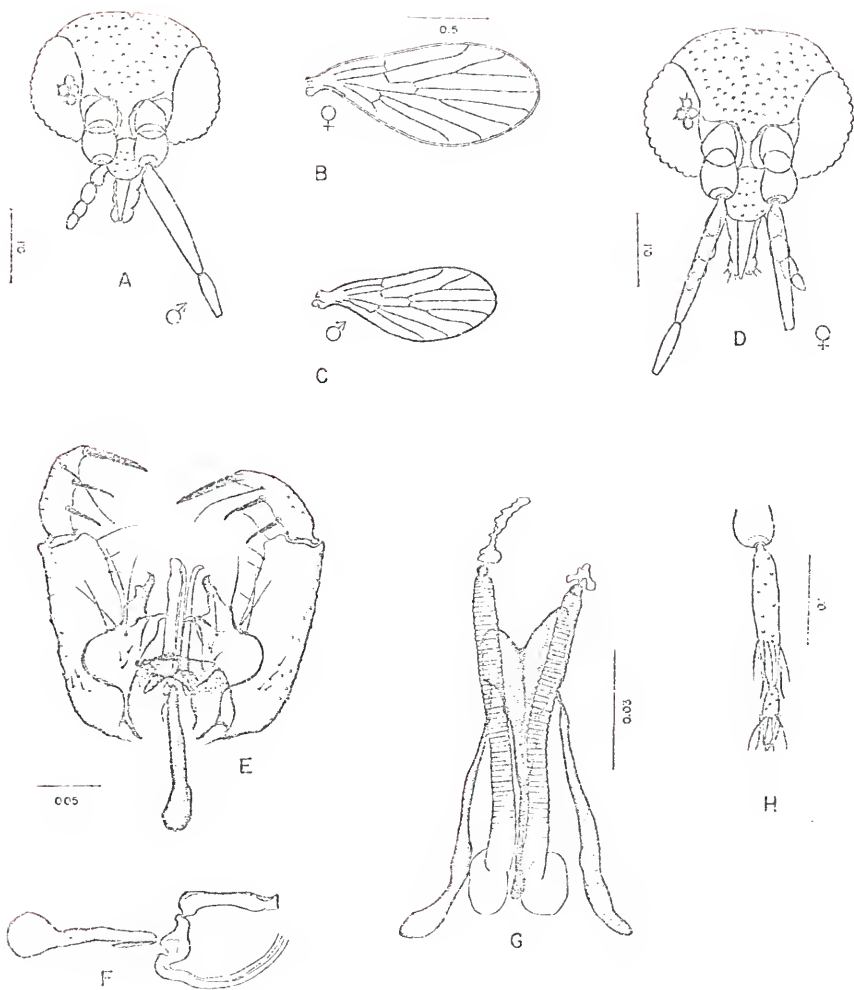


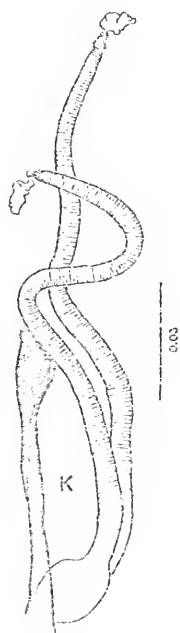
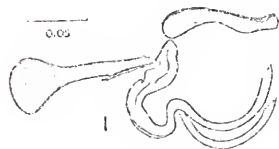
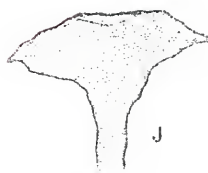
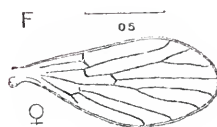
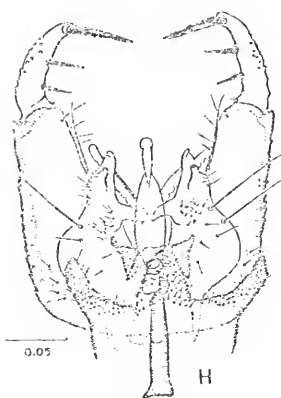
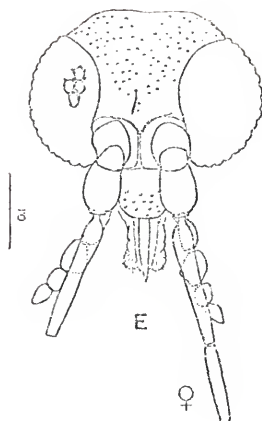
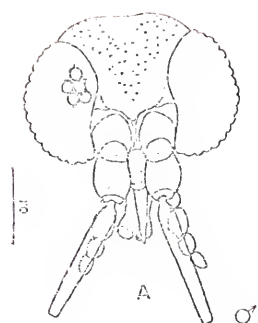


Figure 5

*Sycorax trispinosa* -- A. Male head, B. Female palpus, C. Female, terminal 4 flagellomeres, D. Female pedicel and flagellomeres I and II showing ascoids, E. Female head, F. Female wing, G. Male wing, H. Male genitalia, dorsal view, I. Sperm pump, genital filaments, and median dorsal process of aedeagus, lateral view, J. Tip of furca, dorsal view, K. Spermathecae.

Male: Anchicaya Dam, Valle Dept., Colombia

Female: Same locality as male



## SUBFAMILY PHLEBOTOMINAE

Previous studies on this subfamily in Colombia were reviewed by Osorno et al. (1972a) and will not be repeated here except for literature citations in the species accounts. Nearly all of these studies involve systematics, especially species descriptions and distribution records. Owing to the paucity of bionomic studies on the Colombian phlebotomines, I felt that it would be desirable to provide references to such studies carried out in other countries. The results of these studies may not always apply to conspecific populations in Colombia. Information on the biting habits of some species in Choco Dept. is provided in the species accounts.

With few exceptions I have not redescribed known taxa because of adequate original or subsequent descriptions. Hopefully, the figures and keys will serve to distinguish the taxa.

### Key to the New World Genera

1. Wing broad, rounded at tip;  $R_2 + R_3 + R_4$  forks before, on same level as, or slightly beyond r-m crossvein. Pleura without episternal setae. Female cibarium unarmed. Male genitalia with style longer than coxite . . . . . *Warileya* (Fig. 6-7)
- Wing pointed at tip;  $R_2 + R_3 + R_4$  forks well beyond r-m crossvein. Pleura with episternal setae. Female cibarium armed with teeth. Male genitalia with style shorter than coxite . . . . . 2

2. Interocular suture complete. Female cibarium with 4 longitudinal rows of horizontal teeth. Male genitalia with 5 large spines, 2 of which (usually basal pair) borne on a common tubercle . . . . .  
. . . . . *Brunptomysia* (Fig. 8-11)

Interocular suture incomplete. Female with 1 row of horizontal teeth; vertical and lateral teeth present or not. Male genitalia with style bearing 1-6 large spines, basal pair not borne on a common tubercle in those species having 5 spines . . . *Lutzomyia* (Fig. 12-89)

Genus *Warileya* Hertig, 1948

This genus, recently enlarged to accomodate *W. (H.) hertigi* (Fchld.) by Lewis et al. (1978), contains 5 species, 2 of which in the subgenus *Warileya* occur in Colombia. Little is known about the habits of any of the species although *W. (W.) rotundipennis*, one of the Colombian species, and *W. (W.) phlebotomanica* Hertig, the type species from Peru, are anthrophilic.

Keys to Species

Males

1. Palpal segment 5 longer than combined length of segments 2 + 3.

Paired intraabdominal rods present. Genital filaments about 1.8X length of pump. Style lacking a basal bristle. Wing length less than 1.5 mm. . . . . *nigrosacculus* (Fig. 6)

Palpal segment 5 shorter than combined length of segments 2 + 3.

Intraabdominal rods absent. Genital filaments less than 1.3X length of pump. Style with a basal bristle. Wing length over 1.8 mm . . . . . *rotundipennis* (Fig. 7)

Females

1. Spermathecae large and sac-like with smooth walls. Palpal segments 5 longer than combined length of segments 2 + 3. Wing length less than 2.0 mm. . . . . *nigrosacculus* (Fig. 6)

Spermathecae cylindrical, somewhat worm-like, with transverse striations. Palpal segment 5 shorter than combined length of segments 2 + 3. Wing length over 2.0 mm. . . . . *rotundipennis* (Fig. 7)

5. *Warileya (W.) nigrosacculus*  
(Fig. 6)

*Warileya nigrosacculus* Fairchild & Hertig, 1951b: 428 (♀ holotype, Cerro Campana, Panama Prov., Panama). Fairchild, 1953: 102 (cf. to *Hertigia hertigi*). Barretto, 1955a: 188 (listed). Forattini, 1971a: 107 (listed). Tesh et al., 1971a: 153 (blood meals, Panama). Martins & Morales, 1972: 366 (listed). Young & Chaniotis, 1972: 97 (♂, descr.). Chaniotis et al., 1972: 95-96 (in tree hollows, Panama). Christensen, 1972a: 88 (listed). Forattini, 1973: 536-538 (♀, fig. ). Velasco & Trapido, 1974: (cf. to *W. yungasi*). Lewis, 1975a: 500 et seq. (mouth-part morphol.). Lewis et al., 1978 (classif.).

*Distribution:* Colombia (Choco, Valle), Panama.

*Material examined:* Colombia: 1 ♂, 1 ♀, Curiche (Choco), Malaise trap, 27 April 1977. 1 ♂, 1 ♀, Anchicaya Dam (Valle), light trap, 28 Jan. 1975, R.C.W. 1 ♂, same data but taken 16 July 1975. Panama: ♀ holotype, Cerro Campana (Panama Prov.), hollow log, 7 Jan. 1947, M. Hertig. 2 ♂♂, 5 ♀♀, near Gamboa, Canal zone, tree hollow, 10 Sept. 1969, B. Chaniotis. 4 ♂♂, same data but taken 15 Jan. 1970.

*Discussion:* A little known species, *W. nigrosacculus* is easily distinguished from *W. rotundipennis* by the characters given in the key. Using a precipitin test for blood meal determinations, Tesh et al. (1971a) found that blood from 4 recently engorged *nigrosacculus* females reacted with mammalian and reptile-amphibian antisera. Four other blood meals were nonreactive due to small volumes of blood and/or to the weakness of the reptile-amphibian antisera.

6. *Warileya (W.) rotundipennis*  
(Fig. 7)

*Warileya rotundipennis* Fairchild & Hertig, 1951b: 424 (♂ holotype, ♀, Cerro Campana, Panama Prov., Panama). Fairchild, 1953: 102 (cf. to *Hertigia hertigi*). Barretto, 1955a: 188 (listed). Fairchild & Hertig, 1959: 122 (Costa Rica). Johnson & Hertig, 1961: 765, 775 (rearing). Hanson, 1968: 93 (larval fig.). Forattini, 1971a: 107 (listed). Young & Chaniotis, 1972: 366 (listed). Christensen, 1972a: 88 (listed). Forattini, 1973: 536-538 (♂, ♀ fig.). Velasco & Trapido, 1974: 436 (cf. to *W. yungasi*). Lewis, 1975a: 500 et seq. (mouthpart morphol.). Lewis, 1975b: 366 (hair sockets, fig.). Lewis et al.: 1978 (classif.).

*Distribution:* Colombia (Antioquia, Choco, Valle), Costa Rica, Panama.

*Material examined:* Colombia. 2 ♀♀, Teresita (Choco), tree buttress, 15 June 1967. 27 ♀♀, Rio Anori (Antioquia), light traps, Sept. 1970. 5 ♀♀, same data but 29 May 1970, C.H.P. 8 ♂♂, 2 ♀♀, Anchicaya Dam (Valle), light trap, 28 Jan. 1975, J.E. Browne. 6 ♂♂, 6 ♀♀, same data but taken 10 June 1975, R.C.W. 5 ♂♂, 4 ♀♀, same data but taken 16 July 1975. Panama. ♂ holotype (no. 2335), ♀ allotype (no. 2312), Cerro Campana (Panama), Shannon trap, 24 Aug. 1950, M. Hertig & G. Fairchild. 2 ♂♂, Rio Changena (Bocas del Toro), Shannon trap, 8-11 Sept. 1961, R. Hartmann & P. Galindo. Costa Rica. 2 ♂♂, 1 ♀, Turrialba, Shannon trap, 20 Aug. 1961, G. Fairchild & M. Hertig.

*Discussion:* *Warileya rotundipennis*, the only *Warileya* species lacking intra-abdominal rods (Lewis et al., 1978), has been reported feeding on man in Panama (Fairchild & Hertig, 1951b) but its role, if any, in disease transmission is not known. Dr. C.H. Porter also has collected man-biting

Females at the Rio Anori (Antioquia) locality, mostly in forest clearings (pers. comm.).

The records of *W. rotundipennis* and *W. nigrosacculus* from Choco and Valle Depts. indicate that both taxa probably occur in other areas of the *trans*-Andean region perhaps as far south as Guayas Prov., Ecuador.



Figure 6

*Harileya nigrosucculus* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, dorsal, G. Tips of genital filaments, H. Female wing, I. Male wing, J. Spermathecae.

Male: Curiche, Choco Dept., Colombia

Female: Same locality as male

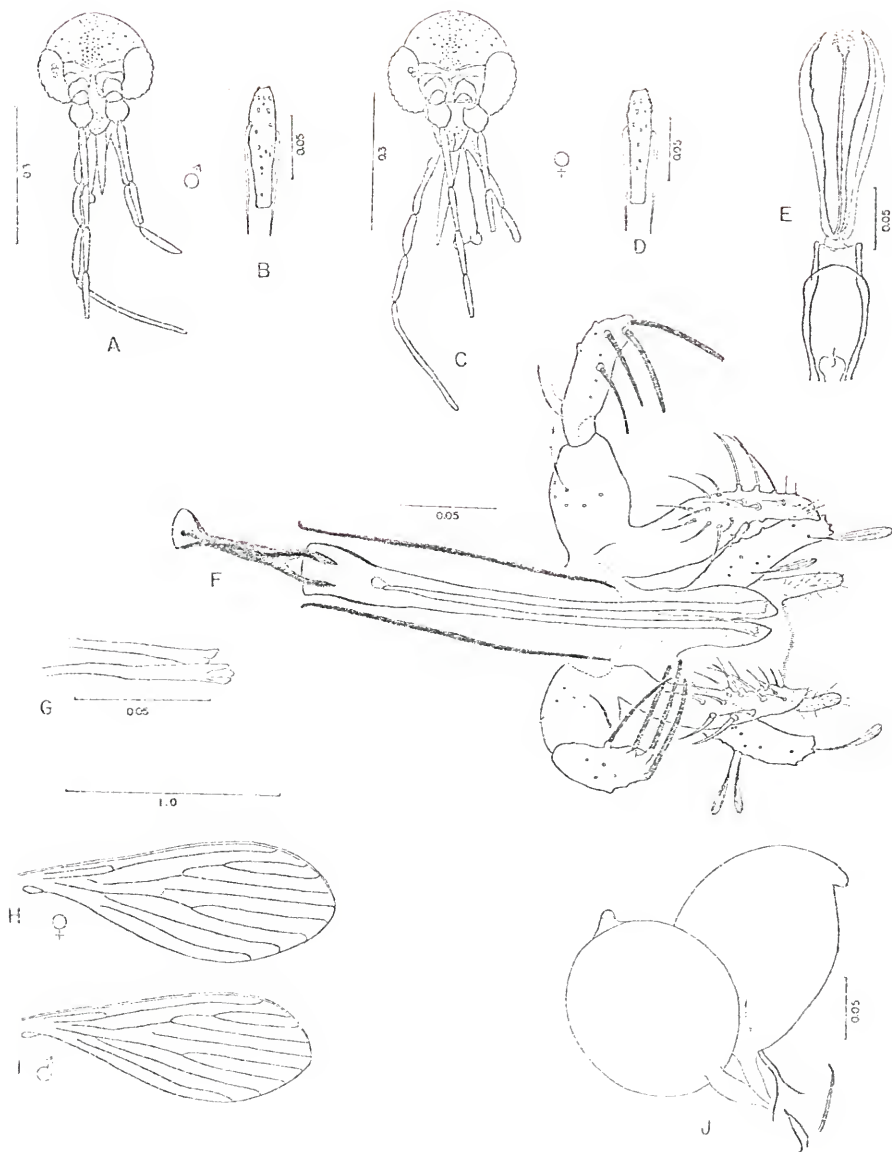
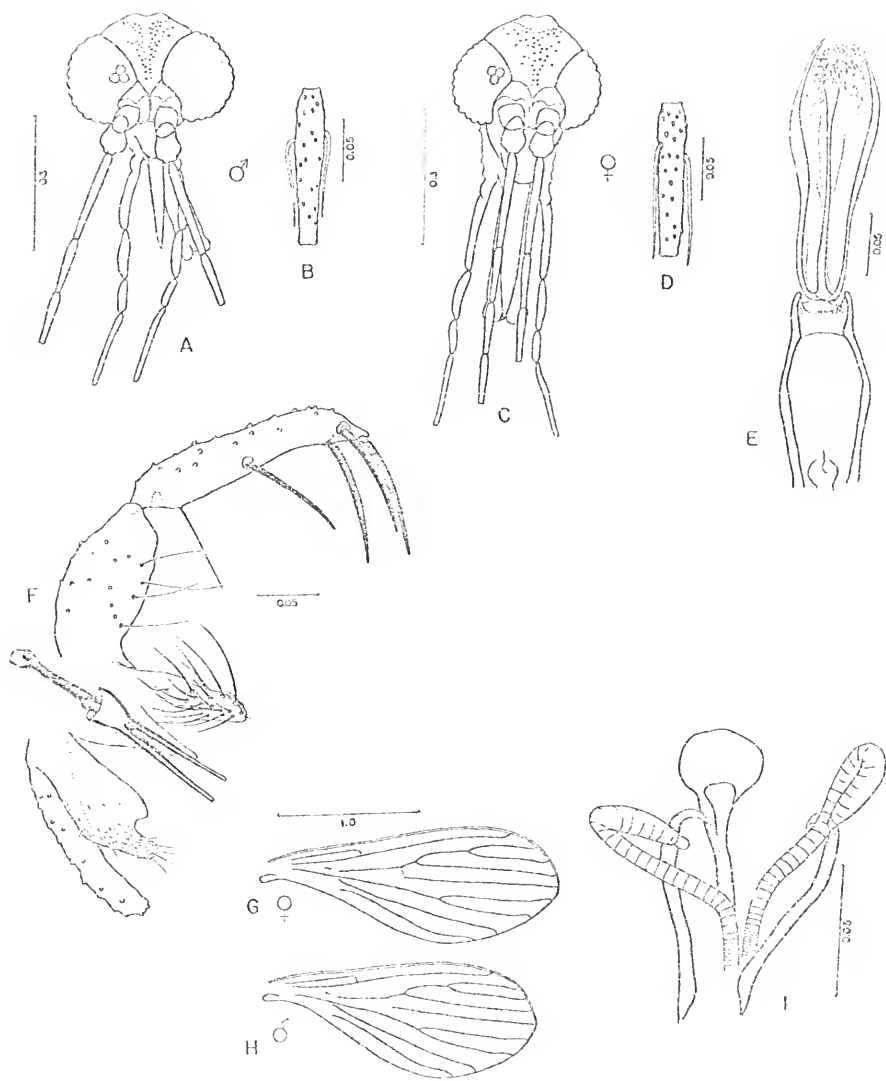


Figure 7

*Harileya rotundipennis* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, G. Female wing, H. Male wing, I. Spermathecae.

Male: Cerro Campana, Panama Prov., Panama

Female: Rio Anori, Antioquia Dept., Colombia



Genus *Brumptomyia* França and Farrot, 1921

Characterized by Theodor (1965), Lewis et al. (1978), and others, the genus *Brumptomyia* now contains over 21 species, 5 of which occur in Colombia. Except for the female of *B. hamata* which has very short spermathecae (Fig. 10I), the females of the other species in Colombia are virtually impossible to identify in the absence of males.

*Brumptomyia avellari*, one of the Colombian species, was reported feeding on armadillos in Brazil (Mangabeira, 1942b). This and other *Brumptomyia* spp. often rest in burrows dug by these mammals. They do not bite man and the preferred hosts of most species remain unknown.

Key to Species

Males

1. Genital filaments less than 4X length of pump. . . . *hamata* (Fig. 10)  
Genital filaments greater than 4X length of pump . . . . . 2
2. Coxite tuft of mostly stout, spine-like setae. . . . . 3  
Coxite tuft of slender, hair-like setae. . . . . 4
3. Coxite tuft of 20+ setae implanted on a distinct tubercle. Parameres more slender as shown. . . . . *galindoi* (Fig. 9)  
Coxite tuft of fewer than 20 setae, usually about 12, not implanted on a tubercle. Paramere broader as shown. . . . . *avellari* (Fig. 8)
4. Style with isolated spine well distad of proximal pair. Coxite tuft implanted on a distinct raised tubercle. . . . . *beaupertuyi* (Fig. 8)

Style with isolated spine at or near level of proximal spines. Coxite tuft implanted on a slightly raised, raspberry-like (circular) base. . . . . *leopoldoi* (Fig. 11)

7. *Brumptomyia avellari*  
(Fig. 8)

*Phlebotomus avellari* Costa Lima, 1932: 48 (♂, Lassance, Minas Gerais, Brazil). Mangabeira, 1942b: 225 et seq. (immatures, adults, descr., fig.). Barretto, 1947: 187-188 (full refs.). Fairchild & Hertig, 1947a: 615-616 (cf. to *galindoi*). Barretto, 1951: 212 (dist.). Floch & Abonnenc, 1952: 39, 45 (♂, ♀, keyed). Rodriguez, 1953b: 55 (mention). Forattini, 1954: 214-217 (second sternite, fig.). Forattini & dos Santos, 1955: 17 (Brazilian record). Ortiz, 1963: 320 (♀, keyed).

*Brumptomyia avellari*: Barretto, 1955a: 187 (listed). Martins et al., 1951b: 309 (mention). Martins et al., 1962a: 380 (Goias, Brazil). Sherlock, 1962: 332, 335 (mention). Carneiro & Sherlock, 1964: 315 (pupa, keyed, fig.). Fraiha et al., 1970a: 468 (♂ keyed). Christensen, 1972a: 88 (Panama). Osorno et al., 1972a: 14 (Boyaca, Colombia). Forattini, 1973: 122 et seq. (gen. review, fig.). Llanos et al., 1976: 480 (Peru). Martin et al., 1976b: 496 (Peru). Ramirez et al., 1976: 599 (Venezuela).

*Distribution*: Panama, Colombia (Boyaca), Peru, Venezuela, Brazil, Paraguay.

*Material examined*: Colombia. 2 ♂♂, 1 ♀, Puerto Boyaca (Boyaca), light trap, 6 May 1973, C.J.M. Brazil. 1 ♂, Coqueiros (Sao Paulo), armadillo burrow, Oct. 1953, Albertin. Panama. 1 ♂, Tocumen Airport (Panama), light trap, 23 March 1953, F. Blanton. Paraguay. 5 ♂♂, Aca-Poi, San Pedro, burrow, 18 April 1950, M. Hertig.

*Discussion:* *Brumptomyia avellari* and *B. brumpti* (Larousse) with sympatric populations in Brazil and Paraguay, closely resemble one another, the males differing chiefly by the shape of the parameres. I regard the Colombian specimens as being conspecific with the former species.

8. *Brumptomyia beaupertuyi*  
(Fig. 8)

*Phlebotomus beaupertuyi* Ortiz, 1954: 235 (♂ holotype, Duaca, Lara State, Venezuela). Scorza & Ortiz, 1960: 434 et seq. (ecology). Pifano et al., 1962: 383, 387 (♂, ♀, keyed), 411-412 (♂, ♀, descr., fig.). Ortiz, 1963: 322 (♀ descr.). Ortiz & Scorza, 1963: 350 (listed), 354 (♂ keyed). Ortiz, 1965a: 208 (mention). Scorza et al., 1967: 193, 195 (♂, ♀ keyed). Leon, 1969: 30 (listed).

*Phlebotomus galindoi* (not *galinãoi* Fairchild & Hertig, 1947): Pifano & Ortiz, 1952: 138 (listed, Venezuela). Leon, 1969: 30 (listed).

*Brumptomyia beaupertuyi*: Barretto, 1955a: 187 (listed). Sherlock, 1962: 321 et seq. (♂, fig., Colombia). Fraiha et al., 1970a: 468 (♂, keyed). Forattini, 1971a: 98 (listed). Forattini, 1973: 522 et seq. (gen. review, fig.).

*Distribution:* Colombia (Santander), Venezuela.

*Material examined:* Venezuela. 2 ♂♂ (topotypes), Duaca (Lara), no date, I. Ortiz.

*Discussion:* At present, this little-known species is represented in Colombia by a single male, skillfully illustrated by Dr. O. Mangabeira (in Sherlock, 1962). Ortiz (1963) described the female based on Venezuelan specimens.

9. *Brumptomyia galindoi*  
(Fig. 9)

*Phlebotomus galindoi* Fairchild & Hertig, 1947a: 615 (♂ holotype, near Boquete, Chiriqui Prov., Panama). Floch & Abonnenc, 1952: 40 (♂ keyed). Ortiz, 1954: 238 (cf. to *beaupertuyi*). Rosabal, 1954: 30 et seq. (♂ fig., Costa Rica). Fairchild & Hertig, 1959: 122 (geographic records). Hanson, 1961: 320 et seq. (breeding sites, Panama). Johnson & Hertig, 1961: 765 et seq. (rearing data). Diaz-Najera, 1963: 193 et seq. (♀ descr., Mexico, fig.). Ortiz & Scorza, 1963: 354 (♂ keyed). Biagi et al., 1966: 149 (Mexican records), 151 (♂ fig.). Strangways-Dixon & Lainson, 1966: 193 (Belize). Hanson, 1968: 56-58 (larva, pupa, descr., fig.).

*Brumptomyia galindoi*: Barretto, 1955a: 187 (listed). Osorno et al., 1972a: 14-15 (Colombian records). Forattini, 1973: 122 et seq. (gen. review, fig.). Lewis, 1975a: 500 et seq. (mouthpart morphol.).

*Brumptomyia mesai* Sherlock, 1962: 332 (♂, San Vicente de Chucuri, Santander, Colombia). Williams, 1970: 331 (Belize). Fraiha et al., 1970a: 468-469 (as synonym of *galindoi*). Forattini, 1971a: 98 (listed). Williams, 1976a: 603 et seq. (in caves, Belize).

*Distribution*: Mexico, Belize, Honduras, Costa Rica, Panama, Colombia (Caqueta, Choco, Bolivar, Boyaca), Ecuador, Paraguay.

*Material examined*: Colombia. 1 ♂, Puerto Boyaca (Boyaca), light trap, 6 May 1973, C.J.M. 1 ♂, Tres Esquinas (Caqueta), light trap, 11 Nov. 1971, C.J.M. 27 ♂♂, 11 ♀♀, Teresita (Choco), light & Malaise traps, tree trunks, April-Aug. 1967, D.G.Y. Costa Rica. 1 ♂, San Carlos (Alajuela) tree buttress, 23 June 1955, R. Rosabal. Ecuador. 5 ♂♂, 4 ♀♀, Río Napo at Limoncocha (Napo), light & flight traps, tree buttresses,



20-24 May 1976, D.G.Y. & T. Rogers. *Honduras*. 1 ♂, Tela, Lancetilla Valley, tree buttress, 24 July 1953, W. Hils. 1 ♂, same data but light trap, 13 Jan. 1954. *Mexico*. 2 ♂♂, 2 ♀♀, Ocoscoautla (Chiapas), tree hollows, 8 April 1951, G. Fairchild & R. Hartmann. 2 ♂♂, Palenque (Chiapas), tree buttresses, 30-31 March 1951, G. Fairchild & R. Hartmann. *Paraguay*. 1 ♂, Sommerfeld, Yhu, tree cavity, 15 March 1950, V. Zelada. 1 ♂, same data but 18 March 1950, M. Hertig. *Panama*. 1 ♂ (holotype no. 814), type locality, 17 Feb. 1947, P. Galindo. 1 ♀, same data but 26 March 1948. 1 ♂, 1 ♀, Mojinga Swamp near Ft. Sherman, Canal Zone, light trap, 19 Nov. 1951, F. Blanton.

*Discussion:* The holotype of *B. galindoi* is a large specimen, wing length nearly 3.0 mm, from Chiriqui Province, Panama (ca. 1200 m above sea level). Smaller specimens from lower elevations in Santander Department, Colombia were later named *B. mesai* by Sherlock (1962) who separated the males on size, number of distal setae on the coxites, shape of the aedeagi and setation of the parameres. Fraiha et al. (1970a) treated the taxa as conspecific, basing their decision on the original descriptions and on a male (identified as *B. galindoi* by Dr. G.B. Fairchild) from a lowland locality in Panama.

Aside from size and the number of distal coxite setae (7 in the *galindoi* holotype, 5-6 in males from the lowlands), I can detect no marked differences among the specimens listed above. The number of distal setae on the coxites probably varies according to the size of the insect and in this case, apparently represents infraspecific variation. It remains to be determined whether or not the size of *galindoi* individuals is correlated with altitude, i.e., is there a continuous increase in size of specimens from the lowlands to the highlands? Believing this to be the case but

without evidence to support it, I tentatively consider *B. mesai* and *B. galindoi* to be conspecific following Fraiha et al. (1970a).

10. *Brumptomyia hamata*  
(Fig. 10)

*Phlebotomus hamatus* Fairchild & Hertig, 1947a: 614 (♂ holotype, Chilibrillo bat caves, near Chilibre, Panama). Barretto, 1951: 217 (mention). Floch & Abonnenc, 1952: 39 (♂ keyed). Rodriguez, 1953b: 53 (♂, ♀ measured, Ecuador), 55 (cf. to *leopoldoi*). Ortiz, 1954: 237 (listed). Lewis & Garnham, 1959: 83-84 (♂, Belize, fig.). Garnham & Lewis, 1959: 24 (Belize). Hanson, 1961: 320 et seq. (breeding sites, Panama). Johnson & Hertig, 1961: 765 et seq. (rearing data). Diaz-Najera, 1963: 193 et seq. (Mexico). Ortiz & Scorza, 1963: 353 (♂, keyed). Disney, 1966: 449 (♂♂ in rodent-baited traps, Belize). Hanson, 1968: 58 (larvae identical to those of *galindoi*).

*Brumptomyia hamata*: Barretto, 1955a: 187 (listed). Sherlock, 1962: 332 (cf. to *mesai*). Williams, 1970: 331 (listed, Belize). Fraiha et al., 1970a: 468 (♂ keyed). Forattini, 1971a: 98 (listed). Rutledge & Mosser, 1972: 300 et seq. (breeding sites, ecology, Panama). Christensen, 1972a: 88 (listed). Forattini, 1973: 139 et seq. (gen. review, fig.). Williams, 1976a: 603 (in caves, Belize).

*Distribution*: Mexico, Belize, Panama, Colombia (Choco), Ecuador.

*Material examined*: Colombia. 1 ♂, Teresita (Choco), hollow tree, 25 March 1967, D.G.Y. 1 ♀ same data but Malaise trap, 17 June 1967. Panama. 1 ♂ (holotype no. 112), type locality, 4 Dec. 1943. 4 ♂♂, 5 ♀♀, lab reared from larvae collected in Canal Zone, 1957-1958, W. Hanson.

*Discussion:* Although the adults of *B. hanata* are rarely encountered, the larvae may be quite common in soil at the base of trees. Hanson (1961) and Rutledge & Mosser (1972) in Panama found that the larvae of this species far outnumber those of other phlebotomine species in this microhabitat. Like other *Brumptomyia* spp., the fourth instar larva has only two caudal setae.

11. *Brumptomyia leopoldoi*  
(Fig. 11)

*Phlebotomus leopoldoi* Rodriguez, 1953b: 52 (♂ holotype, Quevedo, Los Rios Prov., Ecuador; ♀, Naranjal, Guayas Prov., Ecuador). Ortiz, 1963: 320 (♀ keyed).

*Brumptomyia leopoldoi*: Barretto, 1955a: 187 (listed). Sherlock, 1962: 332 (cf. to *mesai*). Williams, 1970: 331 (Belize). Fraiha et al., 1970a: 468-469 (♂ keyed, as possible synonym of *guimaraesi*). Forattini, 1971a: 98 (listed). Christensen, 1972a: 88 (listed, Panama). Forattini, 1973: 530 (as synonym of *guimaraesi*). Williams, 1976a: 603 (in caves, Belize).

*Distribution:* Belize, Panama, Colombia (Antioquia, Choco, Valle), Ecuador.

*Material examined:* Colombia. 3 ♂♂, Rio Anori (Antioquia), light traps, May 1970, C.H.P. 1 ♂, Curiche (Choco), light trap, 26 May 1967, D.G.Y. 2 ♂♂, 5 ♀♀, ca. 10 km W of Cali near Pichinde (Valle), rock crevice, tree trunks and light trap, 31 July 1973-4, Aug. 1973, D.G.Y. & R.C.W. Ecuador. 1 ♂ (paratype no. 4314), Quevedo (Los Rios), no date, J. Rodriguez. 2 ♂♂, 2 ♀♀, 17 km E of Santo Domingo de Los Colorados (Pichincha), mammal burrow, 4 May 1976, D.G.Y. & T. Rogers. 1 ♂, same

data but 27 May 1976. 1 ♂, same data but light trap, 27 May 1976.

*Panama*. 1 ♂ (paratype no. 4292), Almirante (Bocas del Toro), animal burrow, 22 Jan. 1953, W. Hils. 1 ♂, same data but tree buttress, 27 Jan. 1956, R. Hartmann.

*Discussion*: *B. leopoldoi*, considered to be conspecific with *B. guimaraesi* (Coutinho and Barretto) by Forattini (1973), is specifically distinct based upon the following considerations:

1. The nature and size of the basal coxite tufts and the structure and setation of the parameres differ markedly between the two males (cf. Fig. 11C and 11E). The original figure of *leopoldoi* (Rodriguez, 1953b) shows a rather broad paramere but I believe this is a distortion due to mounting technique, not a reflection of normal structure. Paratype no. 4314 is obviously flattened.
2. The genital pump of the *guimaraesi* male is less flared and notably shorter (0.12 mm-0.15 mm) than that of *leopoldoi* which is 0.22-0.24 mm long (cf. Fig. 11G and 11H).
3. The isolated spine of the style of *guimaraesi* is inserted at 0.59-0.61 of the segment whereas that of *leopoldoi* is located at 0.53.

In addition to the *leopoldoi* specimens listed above, I examined 4 *guimaraesi* males from southern Brazil: 2 ♂♂, Faz. Ribeirao de Baizo, Patos, Minas Gerais; 1 ♂, Coqueiros, Sao Paulo; 1 ♂ reared from egg laid by ♀ captured at the type locality (Itaporanga, Sao Paulo, Brazil). I conclude that these allopatric species are distinct, *B. guimaraesi* occurring only in southeastern Brazil as far as known.

Figure 8

*Brumptomyia avellari* male -- A. Genitalia.

Male: Puerto Boyaca, Boyaca Dept., Colombia

*Brumptomyia beaupertuyi* male -- B. Head, C. Flagellomere II, D. Paramere, E. Wing, F. Genital pump and filaments, G. Genitalia, H. Coxite tuft, same scale as Fig. 8A.

Male: Lara State, Venezuela

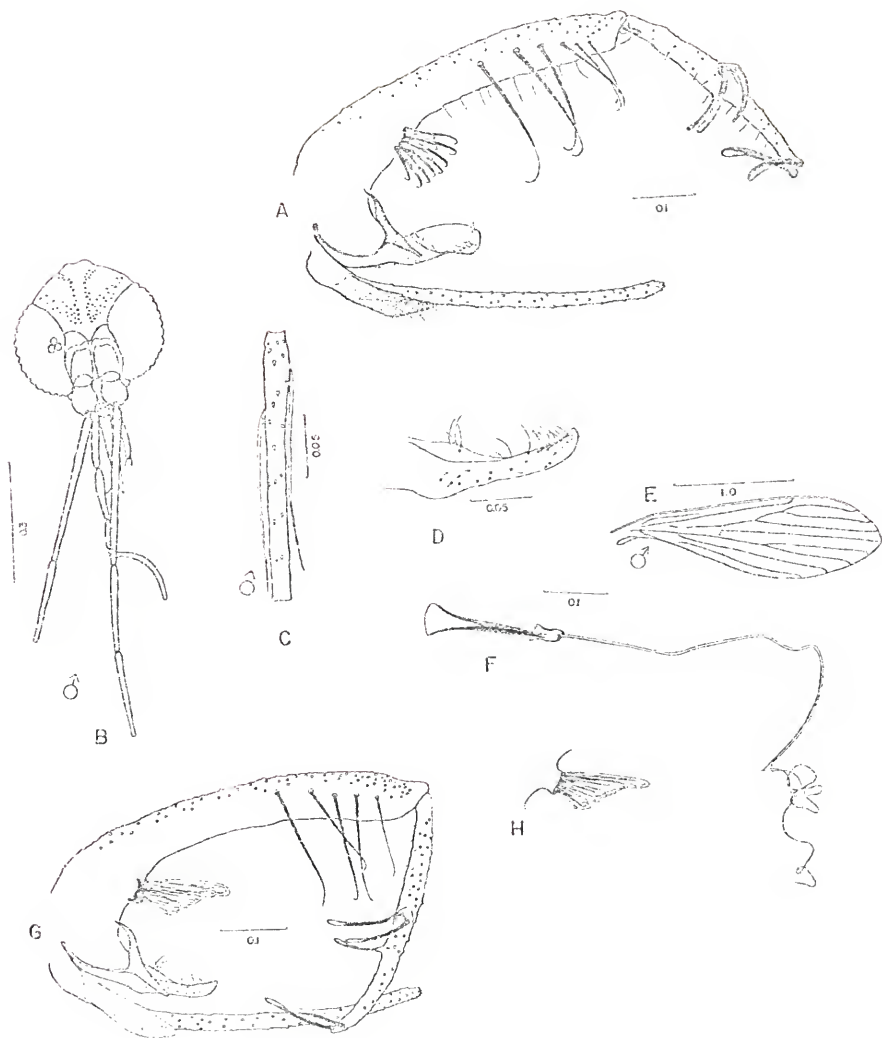
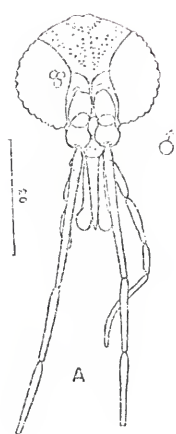


Figure 9

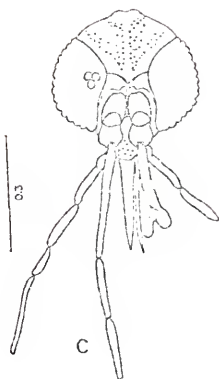
*Breviptomyia galindoi* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Genital pump, G. Genital pump and filaments, H. Male genitalia, I. Paramere, J. Coxite tuft, K. Spermathecae, L. Body of spermatheca, M. Female wing, N. Male wing, O. Female cibarium.

Male: Teresita, Choco Dept., Colombia

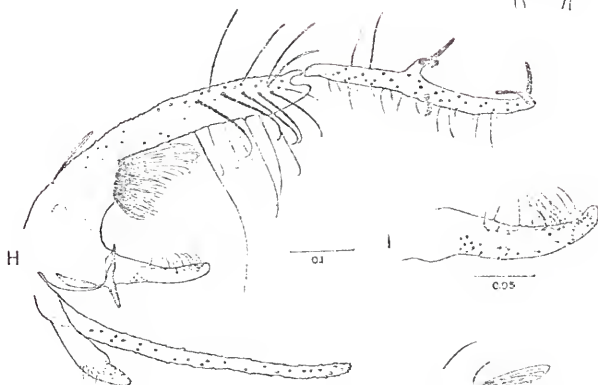
Female: Same locality as male



♂



♀



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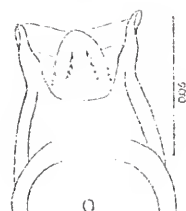
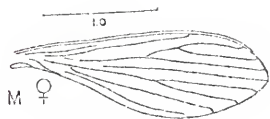
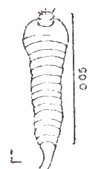




Figure 10

*Brumptomyia hamata* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Genital pump and filaments of male from Teresita, Choco Dept., Colombia, G. Aedeagus and Paramere, H. Male genitalia, I. Spermatheca, the other not drawn, J. Body of spermatheca, K. Female wing, L. Male wing, M. Female cibarium.

Male: Barro Colorado Island, Panama Canal Zone (except Fig. 10F)

Female: Teresita, Choco Dept., Colombia

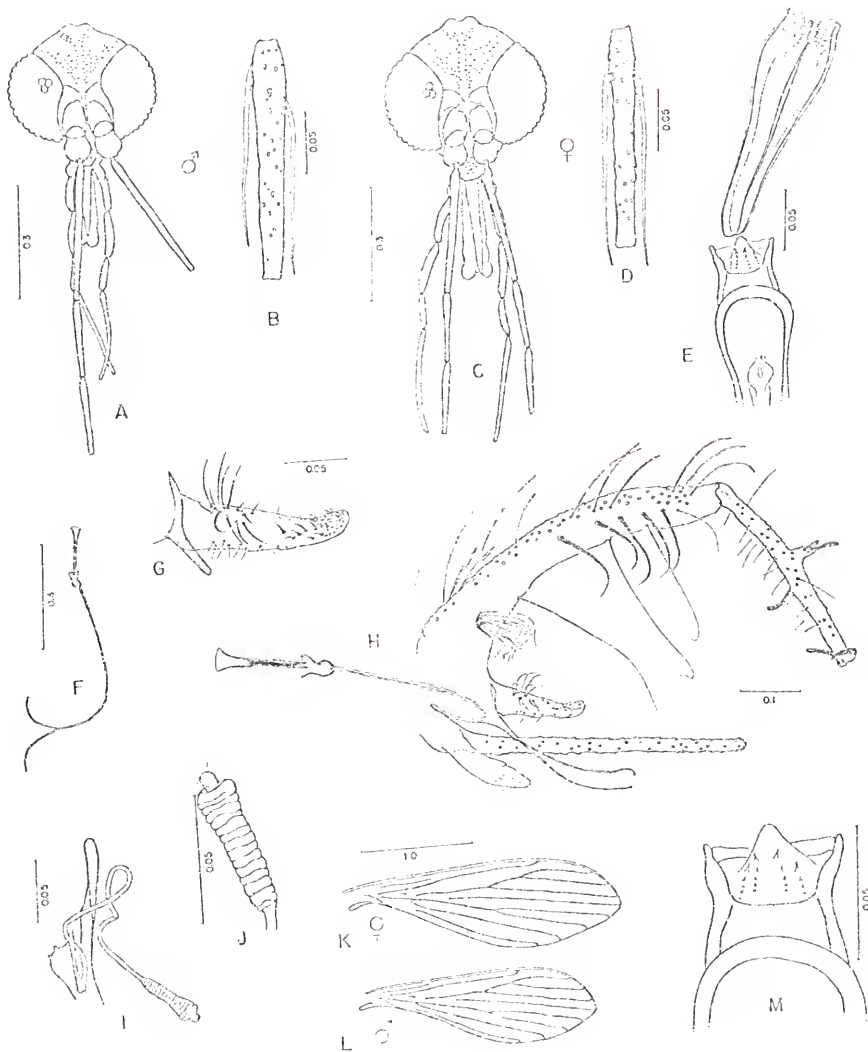


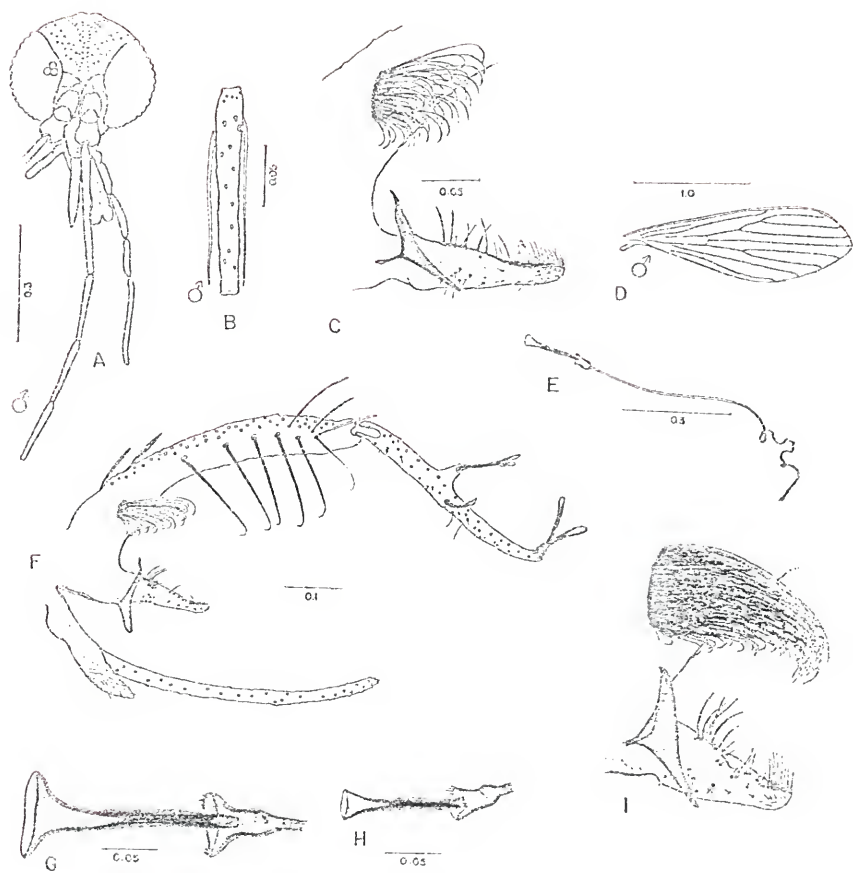
Figure 11

*Brumptomyia leopoldoi* male -- A. Head, B. Flagellomere II, C. Coxite tuft, paramere and aedeagus of male from near Santo Domingo de Los Colorados, Ecuador, D. Wing, E. Genital pump and filaments, F. Genitalia, G. Genital pump of male from Fig. 11C locality.

Male: Rio Anori, Antioquia Dept., Colombia (except for Figs. 11C and G)

*Brumptomyia guimaraesi* male -- H. Genital pump, I. Coxite tuft, paramere and aedeagus, same scale as 11C.

Male: Itaporanga, São Paulo State, Brazil



Genus *Lutzomyia* Franca, 1924

As mentioned earlier the classification of the *Lutzomyia* sand flies is based upon the scheme of Lewis et al. (1978). It should be emphasized that this represents a flexible classification, subject to change as new species, new character states, or unknown sexes are discovered.

It is hoped that the following keys and discussions will be helpful to those interested in sand flies and disease in Colombia and elsewhere in the neotropics.

Keys to Subgenera, Species Groups, and Ungrouped  
Species of *Lutzomyia*

In order to interpret some of the character states in these keys, the user is urged to closely examine the illustrations corresponding to the descriptive statements. Such relative terms as "strong," "small," "inflated," etc. are understood more easily with figures. This also holds true for the male and female genitalia, both of which may be complex and therefore difficult to describe by words alone.

To a certain extent, the *Lutzomyia* subgenera and equivalent species groups are defined by the characters given here. It is important to note, however, that species in some groups, presently unknown in Colombia, may not exactly "fit" into a subgenus or species group as characterized by these keys. For example, *L. nevesi* (Damasceno and Arouck) belongs in the *verrucarum* group although the male, unlike the others, lacks a coxite setal tuft. This species is very common at Limoncocha, Napo Prov., Ecuador -- a locality not far from Putumayo Intendencia, Colombia.

As additional species are discovered in the Republic, these keys obviously will have to be revised. For the present, they are intended to be used with caution, applicable only to the Colombian fauna.

# Males

1. Palp 5 very short, less than half length of third and less than twice length of fourth. . . . . subgenus *Psychodopygus* (Fig. 61-71). . 2  
  
Palp 5 subequal to or longer than half length of third and greater than twice length of fourth . . . . . 4
2. (1) Style with 1 large terminal spine and 3 inconspicuous subapical setae. Coxite with dorsal margin indented near middle. . . . .  
. . . . . series *squamiventris* (Fig. 61)  
  
Style with 2-6 major spines. Coxite not indented near middle . . . 3
3. (2) Style with 2 major spines, both terminal. Paramere simple. . .  
. . . . .series *arthuri*, *L. bispinosa* (Fig. 63)  
  
Style with 3-5 (sometimes 6) major spines. Paramere simple or complex . . . . .series *panamensis* (Fig. 64-71)
4. (1) Lateral lobes markedly inflated . .*vespertilionis* group (Fig. 29)  
  
Lateral lobes not inflated. . . . . 5
5. (4) Lateral lobes with spatulate setae at tips. . . . .  
. . . . . subgenus *Evandromyia*, series *infraspinosa*\*

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\*Species of *Evandromyia* in this series have not been found as yet in Colombia but it is probable that at least one species occurs in the southeastern part of the Republic. The subgenus was reviewed by Young and Arias (1977).

Lateral lobes without spatulate setae . . . . .	6
6. (5) Style deeply forked. Parameres with 2-4 modified apical setae as shown . . . . .	subgenus <i>Viannamyia</i> (Fig. 35-36)
Style simple, not forked. Parameres usually with simple setae but, if modified, then different from above. . . . .	7
7. (6) Style with 2 major spines and 1 or 2 smaller accessory seta . .	8
Style with 3-6 major spines, smaller accessory setae present or not.	9
8. (7) Paramere with a dorsal setiferous arm. Coxite without nondeciduous setae . . . . .	subgenus <i>Dampfomyia</i> , <i>L. rosabali</i> (Fig. 30)
Paramere simple, without a dorsal arm. Coxite with a basal tuft or group of setae. . . . .	<i>verrucarum</i> group, series <i>serrana</i> (Fig. 22)
9. (7) Style with 3 major spines . . . . .	10
Style with 4-6 major spines . . . . .	11
10. (9) Coxite with a basal tuft of simple and modified setae. Style with a small subterminal and a small median seta in addition to the major spines. . . . .	subgenus <i>Pressatia</i> (Fig. 32-34)
Coxite without a basal tuft but with a distal group of 15+ simple setae. Style with only a small median seta and 3 major spines, no subterminal seta. . . . .	<i>pilosa</i> group, <i>L. pilosa</i> (Fig. 86)
11. (9) Style with 4 major spines . . . . .	12
Style with 5, sometimes 6, major spines . . . . .	32

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\*Males of *L. rorotaensis* usually have 5 major spines but those examined from Valle Dept., have but 4 (see p. 421).

12. (11) Antennal ascoids with very long pointed or short blunt basal spurs. Style without a subterminal seta. . . . . 13
- Antennal ascoids with or without basal spurs, but if present they are very short and pointed. Style with or without a subterminal seta. . . . . 14
13. (12) Coxite with 5-8 strong distal setae. Style with isolated basal spine . . . . . *dreisbachi* group (Fig. 50-51)
- Coxite without distal setae. Style with basal spines more or less paired. . . . . *shannoni* group (Fig. 37-42)
14. (12) Palp 5 shorter than palp 3. Style without a subterminal seta. . . . . 15
- Palp 5 as long as or longer than palp 3. Style with or without a subterminal seta. . . . . 18
15. (14) Coxite with 2 or more basal and/or median setae. . . . . 16
- Coxite without nondeciduous setae . . . . . 17
16. (15) Style with basal spine isolated. Antennal ascoids with very short pointed basal spurs. Flagellomere I shorter than flagellomeres II + III. . . . . subgenus *Trishophoromyia* (Fig. 51-54)
- Style with paired basal spines. Antennal ascoids simple, no basal spurs visible. Flagellomere I longer than II + III . . . . .
- . . . . . subgenus *Myssomyia* (in part), *L. artunesi* (Fig. 55)



17. (15) Antennal ascoids with short, pointed basal supr. Paramere with a dorsobasal hump. Flagellomere I shorter than II + III. . . . .  
. . . . . *aragaoi* group (Fig. 45-49)  
  
Antennal ascoids simple. Paramere lacking a dorsobasal hump. Flagellomere I longer than II + III . . . . .  
. . . . . subgenus *Nyssomyia* (in part), (Fig. 55-60)
18. (14) Coxite with 3+ basal and/or median setae in a tuft or group, distal setae may also be present. . . . . 19  
  
Coxite without a basal and/or median group of setae but long ventral setae may be present. . . . . 28
19. (18) Style with 4 short stubby spines, 2 of which are terminal; subterminal seta present. Paramere simple, undivided. Coxite with 4-8 strong distal setae . . . . . *baityi* group, *L. baityi* (Fig. 34)  
  
Style with longer spines; if 2 are terminal then parameres are divided; subterminal seta present or absent. Coxite without distal nondeciduous setae. . . . . 20
20. Hind femur with a row of 3-5 short spines . . . . .  
. . . . . subgenus *Pintomyia*, *L. spinosa* (Fig. 31)  
  
Hind femur without spines . . . . . 21
21. (20) Paramere with 2 dorsobasal setae, much longer than others, hooked or fan-shaped. . . . .  
. . . . . subgenus *Lutzomyia*, series *longipalpis* (Fig. 13-15)  
  
Paramere without such setae . . . . . 22

22. (21) Style with a subterminal seta . . . . . 23
- Style without a subterminal seta. . . . . 26
23. (22) Genital filament tips enlarged, spoon-shaped, each with a distinct inner "tooth" . . . *migonei* group, series *walkeri* (Fig. 19-20)
- Genital filament tips enlarged or not but lacking an inner tooth. 24
24. (23) Coxite with setae of basal tuft shorter than width of coxite . . . . . *migonei* group, *L. migonei* (Fig. 18)
- Coxite with setae of basal tuft longer than width of coxite . . . 25
25. Mesonotum & pleura pale . . *saulensis* group,\* *L. saulensis* (Fig. 21)
- Mesonotum distinctly darker than pleura . . . . .
- . . . . *verrucarum* group, series *verrucarum* (in part), (Fig. 23-24)
26. (22) Coxite with basal setae inserted on a raspberry-like, subcircular base. . . . . subgenus *Lutzomyia*, series *cruciata* (Fig. 16-17)
- Coxite with basal setae, if present, not implanted on such a base. 27
27. (26) Style with paired basal spines. Coxite with basal tuft of slender, subequal setae . . . . . *verrucarum* group, series *verrucarum* (in part), *L. nunezovari* (Fig. 23)
- Style with basal spine isolated. Coxite with either basal-median setae, 1 at least larger than others, or with a patch of slender distal setae . . . . . *cayennensis* group, series *atroclavata* (Fig. 81-82)

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\*I am unable to separate the males on the group level using structural characters.

28. (18) Style with a small subterminal seta. . . . . 29
- Style without a small subterminal seta. . . . . 31
29. (28) Paramere divided. Coxite with long ventral setae. . . . .
- . . . . . *longispina* group (Fig. 43-44)
- Paramere simple, undivided. Coxite without long ventral setae. . 30
30. (29) Palp 5 shorter than segments 3 + 4. Eyes large. Paramere slender, its width less than that of style. . . . .
- . . . . . ungrouped, *L. sp.* of *Anchicaya* (Fig. 89)
- Palp 5 longer than segments 3 + 4. Eyes small. Paramere broad, its width greater than that of style. ungrouped, *L. rangeliana* (Fig. 88)
31. (28) Style with isolated basal spine. Flagellomere I longer than head height; ascoids with very short basal spurs. Palp 5 shorter than segments 3 + 4 . . . . . ungrouped, *L. nordestina* (Fig. 87)
- Style with paired basal spines. Flagellomere I shorter than head height; ascoids without visible basal spurs. Palp 5 longer than segments 3 + 4 . . . *cayennensis* group, series *cayennensis* (Fig. 79-80)
32. (11) Style with a small subterminal seta. . . . .
- . . . . . *oswaldoi* group (in part), *L. pia* (Fig. 83)
- Style without a small subterminal seta. . . . . 33
33. (32) Coxite with 2 or more setae at base; others may extend to middle of structure forming a loose or compact tuft. . . . .
- . . . . . *vexator* group, series *peruensis* (Fig. 72-78)

Coxite without setae at base but with a few scattered setae near middle of coxite. . . . . *oswaldoi* group (in part), (Fig. 84-85)

# Females

1. Spermathecae associated with paired sclerotized structures, intracellular ducts (= "hairs") covering most of spermathecae . . . . .  
. . . . . subgenus *Viannanyia* (Fig. 35-36)

Spermathecae without associated sclerotized structures, intracellular ducts confined to small area, usually but not always, to terminal knob. . . . . 2

2. (1) Pharynx with posterior spines. . . . . 3

Pharynx without spines. . . . . 6

3. (2) Cibarium with inner pair of horizontal teeth pointing inwards . . . . .  
. . . . . *oswaldoi* group (in part), *L. trinidadensis* (Fig. 85)

Cibarium with horizontal teeth pointing toward pharynx, not slanted . . . . . 4

4. (3) Cibarium with 10+ horizontal teeth in a comb-like row . . *cayennensis* group, series *cayennensis* (in part), *L. cayennensis* (Fig. 79)

Cibarium with 4 horizontal teeth not in a comb-like row . . . . . 5

5. (4) Foreleg with femur longer than tibia. Pharynx markedly enlarged with prominent, subequally spaced transverse ridges and conspicuous spines. Pleura pale. . . . .  
. . . . . *cayennensis* group, series *atroclavata* (Fig. 81-82)

- Foreleg with femur shorter than tibia. Pharynx more slender, the transverse ridges and spines less defined. Pleura dark . . . . .
- cayennensis* group, series *cayennensis* (in part), *L. micropyga* (Fig. 80)
6. (2) Spermathecae with bubble-like expansions. . . . . 7
- Spermathecae without bubble-like expansions . . . . . 8
7. (6) Cibarium with 4 broad and blunt horizontal teeth and conspicuous lateral teeth. Mesonotum well pigmented, darker than pleura. Eyes very small. . . . . subgenus *Dampfomyia*, *L. rosabali* (Fig. 30)
- Cibarium with 4 slender, sharp horizontal teeth, without obvious lateral teeth. Mesonotum and pleura pale. Eyes larger . . . . .
- . . . . . *saulensis* group, *L. saulensis* (Fig. 21)
8. (6) Antennal ascoids with long pointed or short blunt basal spurs . 9
- Antennal ascoids simple or with short pointed basal spurs . . . . .10
9. (8) Cibarium with 10+ horizontal teeth. Spermathecae distinctly annulated . . . . . *dreisbacki* group (Fig. 50-51)
- Cibarium with 4-8 horizontal teeth. Spermathecae annulated or not . . . . .
- . . . . . *shannoni* group (Fig. 37-42)
10. (8) Hind femur with row of 3-5 short spines . . . . .
- . . . . . subgenus *Pintomyia*, *L. spinosa* (Fig. 31)
- Hind femur without spines . . . . . 11
11. (10) Cibarium with 6 or more horizontal teeth . . . . . 12

- Cibarium with 4 horizontal teeth. . . . . 17
12. (11) Individual sperm ducts markedly convoluted, twisted. . . . .  
. . . . . *aragaoi* group, series *brasiliensis*, *L. runoides* (Fig. 49)
- Individual sperm ducts not convoluted as above. . . . . 13
13. (12) Palp 5 equal to or shorter than segments 3 + 4 . . . . . 14
- Palp 5 longer than segments 3 + 4 . . . . . 16
14. (13) Spermathecae larger, sac-like, without annuli. Ascoids with  
short pointed basal spurs. *aragaoi* group, series *aragaoi* (Fig. 45-48)
- Spermathecae smaller, with incomplete or complete annuli. Ascoids  
with or without short basal spurs . . . . . 15
15. (14) Flagellomere I longer than flagellomeres II + III. Ascoids with  
short basal spurs . . . . . subgenus *Trichophoromyia* (Fig. 51-54)
- Flagellomere I shorter than II + III. Ascoids without visible basal  
spurs . . . . . subgenus *Nyssomyia* (Fig. 55-60)
16. (13) Cibarium with 6 horizontal teeth. Spermatheca with terminal  
segment smaller than preceding segment. Common sperm duct longer  
than individual ducts . *oswaldoi* group (in part), *L. pia*\* (Fig. 83)
- Cibarium with 8+ horizontal teeth. Spermatheca with terminal segment  
as large as others. Common sperm duct much shorter than individual

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\**L. pia* is keyed twice because of intraspecific variation in the number  
of horizontal teeth (see p. 419).

- ducts . . . . . subgenus *Intzomyia*, series *longipalpis* (in part), *I. longipalpis* (Fig. 15)
17. (11) Palp 5 shorter than segments 3 + 4 . . . . . 18
- Palp 5 longer than segments 3 + 4 . . . . . 21
18. (17) Spermathecae imbricated, annuli semi-telescoped. Individual sperm ducts heavily sclerotized, wrinkled, or rugose in part or whole . . . . . subgenus *Psychodopygus* (Fig. 61-71)
- Spermathecae not imbricated, annuli, if present, not semi-telescoped. Individual sperm ducts non-rugose, smooth walled or with slight thickenings . . . . . 19
19. (18) Cibarium with inner pair of horizontal teeth pointing inwards. Flagellomere I extremely long, subequal to or longer than combined lengths of palpal segments. Ascoids with very short basal spurs. . . . . ungrouped, *I. nordestina* (Fig. 87)
- Cibarium with horizontal teeth pointing toward pharynx, not slanted inwards. Flagellomere I shorter than palpus. Ascoids without visible basal spurs . . . . . 20
20. (19) Spermathecae as shown, longer than individual sperm ducts. Abdominal tergite 8 without lateral setae . . . . .
- . . . . . *vespertilionis* group, series *vespertilionis* (Fig. 29)
- Spermathecae otherwise, shorter than individual sperm ducts. Abdominal tergite 8 with lateral setae. . . . . 21

21. (20) Spermathecae less than twice as long as wide, terminal segment smaller than preceding segment. Common sperm duct longer than individual ducts. . . . . *oswaldoi* group (in part), *L. pia* (Fig. 83)  
  
Spermathecae cylindrical, its length at least 3 times width, terminal segment subequal to or smaller than others. Common sperm duct shorter than individual ducts . . . . .  
. . . *vexator* group, series *peruensis* (in part), (Fig. 72-74; 76-78)
22. (17) Individual sperm ducts heavily pigmented in part or whole. . .  
. . . . . subgenus *Pressatia* (Fig. 32-34)  
  
Individual sperm ducts not pigmented. . . . . 23
23. (22) Cibarial arch absent or conspicuous only at sides. . . . . 24  
  
Cibarial arch complete or nearly so . . . . . 26
24. (23) Cibarium with horizontal teeth like flattened plates viewed almost edgewise. Common sperm duct absent. . . . .  
. . . . . *pilosa* group, *L. pilosa* (Fig. 86)  
  
Cibarium with horizontal teeth otherwise. Common sperm duct present . . . . . 25
25. (24) Wing venation with *beta* less than half *alpha*. Cibarium with horizontal teeth pointing towards pharynx, not inwardly slanted . .  
. . . . . *vexator* group, series *peruensis* (in part), (Fig. 75)  
  
Wing venation with *beta* over half length of *alpha*. Cibarium with horizontal teeth pointing inwards . . . . .  
. . . . . *oswaldoi* group (in part), *L. rorotaensis* (Fig. 100)



26. (23) Spermathecae completely smooth-walled. . . . . 27
- Spermathecae wrinkled, with transverse striations or indentations forming complete annuli or not. . . . . 28
27. (26) Spermathecae tubular, much longer than wide and only slightly wider than individual ducts. Common sperm duct short, not exceeding one-third length of individual ducts. . . . .
- . . . . . *migonei* group, series *migonei*, *L. migonei* (Fig. 18)
- Spermathecae capsular, about as long as wide, distinctly wider than individual ducts where they enter spermathecae. Common duct over one-third length of individual ducts. . . . .
- . . . . . *migonei* group, series *walkeri* (Fig. 19-20)
28. (26) Spermathecae as shown, with some clearly defined annuli, terminal one hemispherical and larger than others. .subgenus *Lutzomyia*, series *longipalpis* (in part), and series *cruciata* (Fig. 13-14; 16-17)
- Spermathecae otherwise, with transverse striations or wrinkles, terminal segment, if present, not hemispherical . . . . . 29
29. (28) Spermathecae as shown, pear-shaped with fine transverse striations, complete or not. . . . . *longispina* group (Fig. 43-44)
- Spermathecae otherwise, sac-like and wrinkled . . . . . 30
30. (29) Individual sperm ducts nearly absent, spermathecae seemingly joined directly to common duct. Eyes very small. . . . .
- . . . . . ungrouped, *L. rangeli* (Fig. 88)
- Individual sperm ducts at least as long as half length of spermathecae. Eyes large . . . . . *verrucarum* group (Fig. 24-27)

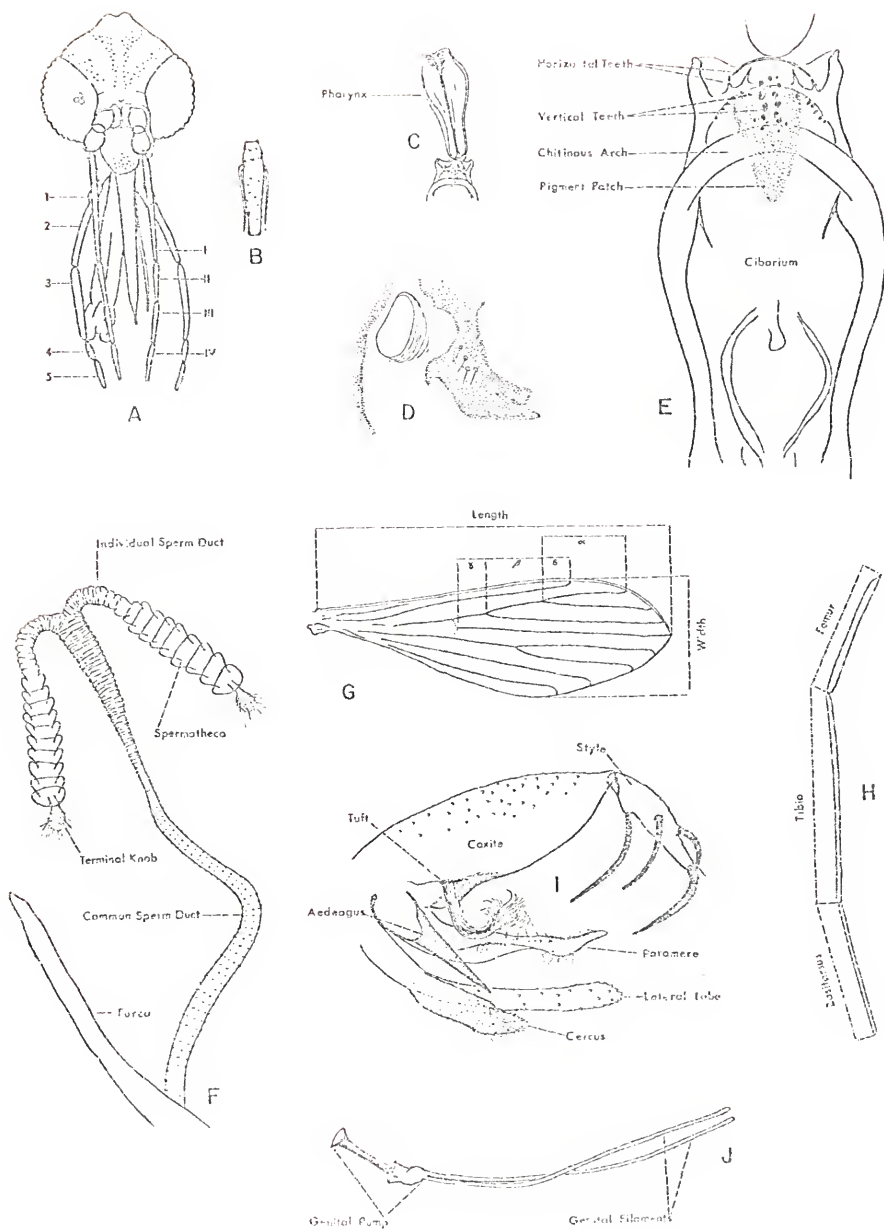
Figure 12

*Lutsomyia (P.) hirsuta nicaraguensis* female -- A. Head with palpal segments marked in Arabic numerals and flagellomeres designated by Roman numerals, B. Flagellomere II showing ascoids, C. Pharynx attached to cibarium, D. Metathoracic spiracle and postspiracular setae, E. Cibarium, F. Spermathecae and associated structures, G. Wing, H. Femur, tibia, and basitarsus of front leg.

Female: Rio Changuena, Bocas del Toro Prov., Panama

*Lutsomyia townsendi* male -- I. Male genitalia; small subterminal seta on style is present, J. Genital pump and filaments, same scale as fig. 12I.

Male: Rancho Grande, Aragua State, Venezuela



Subgenus *Lutzomyia* França, 1924

This subgenus, divided into 3 series (Lewis et al., 1978), contains 21 species including *L. marinkellei* n. sp. described in this review. Seven of these are anthropophilic and others probably share the same habit. *Lutzomyia longipalpis*, the principal vector of visceral leishmaniasis in the New World (Lewis, 1974), ranges from southern Mexico to central Argentina where it is locally common in dry, nonforested areas. *Lutzomyia gomezi*, also reported in Colombia, has been implicated as a vector of dermal leishmaniasis in Panama (Christensen et al., 1969).

In Colombia the series *longipalpis* is represented by 3 species -- *L. longipalpis*, *L. lichyi*, and *L. bifoliata*. Two species, *L. gomezi* and *L. marinkellei* are included in the series *cruciata*. Except for *longipalpis*, the females of these species are remarkably similar and are separated only by minor nonsexual characteristics.

Keys to Species

Males

1. Paramere with long dorsobasal arm bearing apical setae. Coxite with 2 very broad fan-like setae at inner base . . . . . 2
- Paramere without dorsobasal arm. Coxite with 4 or more simple setae at inner base . . . . . 3
2. Paramere with dorsobasal arm bearing 2 slender, recurved setae. Coxite with patch of long setae distad of fan-like setae . . . . . *bifoliata* (Fig. 13)

- Paramere with dorsobasal arm bearing 2 fan-like setae. Coxite without a distal patch of long setae. . . . . *lichyi* (Fig. 14)
3. Paramere with 2 strongly developed, dorsobasal setae. Coxite tuft of 4 setae. Style with a subterminal seta. . . *longipalpis* (Fig. 15)
- Paramere without such setae. Coxite tuft of 10+ setae. Style without a subterminal seta. . . . . 4
4. Pleura entirely pale. Style over half length of lateral lobe. Paramere with dorsal setae on distal half of structure. . *gomezzi* (Fig. 16)
- Pleura mostly dark. Style shorter than half length of lateral lobe. Paramere with short dorsal setae confined to distal third of structure . . . . . *marinkellei* (Fig. 17)

#### Females

1. Cibarium with at least 8 horizontal teeth. Spermathecae as shown, terminal annulation not markedly larger than others . . . . .  
 . . . . . *longipalpis* (Fig. 15)
- Cibarium with 4 horizontal teeth. Spermathecae otherwise, terminal annulation spherical much larger than others. . . . . 2
2. Pleura pale, contrasting with dark mesonotum. Flagellomere I shorter than or equal to length of labrum . . . . . *gomezzi* (Fig. 16)
- Pleura mostly dark. Flagellomere I longer than labrum. . . . . 3
3. Flagellomere I less than 0.32 mm long . . . . . *marinkellei* (Fig. 17)
- Flagellomere I greater than 0.32 mm long. . . . . 4

4. Terminal flagellomere longer than preceding flagellomere (XV) . . .  
 . . . . . *lichyi* (Fig. 14)
- Terminal flagellomere shorter than preceding flagellomere (XV) . . .  
 . . . . . *bifoliata* (Fig. 13)

Series *longipalpis*

12. *Lutzomyia* (L.) *bifoliata*  
(Fig. 13)

*Lutzomyia bifoliata* Osorno, Morales, Osorno, & Hoyos, 1970: 8 (♂, El Terminal, Municip. Puerto Boyaca, Boyaca, Colombia). Osorno et al., 1972a: 15 (listed). Forattini, 1973: 248 (gen. review, ♂ fig.).

*Distribution:* Colombia (Antioquia, Boyaca).

*Material examined:* Colombia. 13 ♂♂, 19 ♀♀, Rio Anori (Antioquia), tree buttresses, Sept. 1970, D.G.Y. 3 ♂♂, 1 ♀, light traps, same locality, May 1970, C.H.P.

*Discussion:* *Lutzomyia bifoliata* males from Rio Anori generally agree with the description and figures given by Osorno et al. (1970) but the strong erect seta on the dorsum of the paramere is lacking in our material. The female, described below, closely resembles *L. lichyi* but the terminal flagellomere is shorter, not longer than the preceding flagellomere. The longer labrum of *bifoliata* females (0.37-0.42 mm as opposed to 0.25-0.36 mm, n = 17, in *lichyi*) also may be useful in distinguishing the species if it proves to be a consistent, nonoverlapping feature.

The following description is based on 10 females captured near the Rio Anori.

*Female*: Wing length 2.35-2.57; width 0.73. Head, mesonotum, and abdominal tergites strongly pigmented: Rest of insect, including most of pleura, paler. Head height 0.46; width 0.44. Eyes separated by 0.14 or distance = to ca. 7.8 facet diameters. Flagellomere I (0.40-0.50 long), 1.2 x length of II + III; ascoids longer than those of ♂, but not reaching ends of flagellomeres, with almost indiscernible posterior spurs, present on all but last flagellomere. Length of palpal segments: 1 (0.06), 2 (0.15-0.18), 3 (0.19-0.21), 4 (0.09-0.12), 5 (0.30-0.37); palpal sensilla on segments 2 and 3. Labrum length = 0.37-0.42. Cibarium with 4 nearly straight, sharp horizontal teeth and 20-30 vertical teeth distributed as shown; chitinous arch complete, well defined; pigment patch subtriangular, darker, and broader posteriorly. Pharynx (0.20 long) unarmed. Pleura with 14-22 upper and 3-5 lower episternal setae. Length of wing vein sections: *Alpha* (0.64-0.71), *beta* (0.27-0.34), *delta* (0.13-0.19), *gamma* (0.27-0.34). Length of femora, tibiae, and basitarsi of slide 618: Foreleg, 0.95, 1.22, 0.74; midleg, 0.91, 1.47, 0.81; hindleg, 0.98, 1.67, 1.27. Abdominal sternite 2 horseshoe-shaped, hollow in middle. Tergite 8 without setae. Spermathecae and sperm ducts as figured.

13. *Lutzomyia* (L.) *lichyi*  
(Fig. 14)

*Phlebotomus lichyi* Floch & Abonnenc, 1950a: 1 (♀ holotype, Rio Borburata, Carabobo, Venezuela). Morales et al., 1969a: 381 (Meta, Colombia).

*Phlebotomus verillarius* Fairchild & Hertig, 1952: 514 (♂, ♀, Panama). Pifano et al., 1960: 65 (Miranda State, Venezuela). Pifano et al.,

1962: 385 (keyed). McConnell & Correa, 1964: 527 (infected with fungi). Flech & Kramer, 1965: 1 (as synonym of *lichyi*). Hanson, 1968: 90 (larva & pupa). Scorza et al., 1968: 35 (bionomics). Calderon, 1973: 87 (Merida State, Venezuela).

*Phlebotomus foliatus* Mirsa & Ortiz, 1952: 249 (♂, Venezuela). Fairchild & Hertig, 1958b: 205 (as synonym of *verillarius*).

*Lutzomyia vexillaria*: Martins et al., 1963: 335 (Roraima, Brazil).

*Lutzomyia lichyi*: Barretto, 1962: 98 (listed). Osorno et al., 1970: 12 (cf. to *L. bifoliata*). Arjona et al., 1971: 93 (biting record, Tolima, Colombia). Osorno et al., 1972a: 16 (Colombian records). Forattini, 1973: 213 (Trinidad), 258 (figs., redescr.). Lewis, 1975a: 500 et seq. (mouthpart morphol.).

*Distribution*: Panama, Colombia (Antioquia, Caldas, Choco, Huila, Magdalena, Santander, Tolima, Valle), Venezuela, Trinidad, Brazil.

*Material examined*: Colombia. 1 ♀, Curiche (Choco), light trap, 16 Aug. 1967, D.G.Y. 4 ♀♀, Alto Curiche (Choco), biting man, July-Aug. 1967, D.G.Y. 1 ♂, Alto Curiche, tree buttress, 4 April 1967, D.G.Y. 1 ♂, Alto Curiche, Shannon trap, 13 Sept. 1967, D.G.Y. 1 ♀, Miraflores, Guatape (Antioquia), light trap, 12 March 1969, P. Barreto. 3 ♀♀, Suaza (Huila), horse bait, 9 March 1971, C. Aguila. 3 ♀♀, 25 km E of Buenaventura (Valle), tree trunks, 11 Aug. 1973, D.G.Y. & R.C.W. 27 ♂♂, 5 ♀♀, 14 km SE of Santa Marta at Minca (Magdalena), tree trunks, 17 Aug. 1973, D.G.Y. & R.C.W. 2 ♀♀, Anchicaya Dam (Valle), light trap, 28 Jan. 1975, J.E. Browne. Venezuela. 1 ♂, 2 ♀♀, no other data, I. Ortiz. Trinidad. 1 ♀, Perserverance cave, Maraval, 22 Nov. 1974, E.S. Tikasingh. Panama. 1 ♂, Serrania Maje, Cerro Chucanti (Pamana), tree buttress, 5 March 1950, R. Hartmann. 1 ♀, Cerro Campana (Panama), Shannon trap, 25 Aug. 1950, M. Hertig.



*Discussion:* Man biting records for this species include those from Panama (Fairchild and Hertig, 1952), Venezuela (Scorza et al., 1968), and Colombia (Osorno et al., 1972a). During the interoceanic canal survey in Choco Dept. at Alto Curiche, we collected only 4 females on human bait during a 5 month period. Each was a daytime catch although routine biting collections were carried out at night as well. Dr. Pablo Barreto (pers. comm.) has collected biting females within the city limits of Cali, Colombia. In Panama, McConnell (1963) found non-mammalian (nucleated) red blood cells in the gut of a resting female and Thatcher and Hertig (1966) captured females feeding on *Didelphis* and *Potos*.

According to Hanson (1968), the larvae of *L. lichyi* (as *vexillarius*) and *L. gomezi* share certain characters not observed in other species. This, along with adult morphology, supports the placement of *L. gomezi* in the subgenus *Lutzomyia*.

14. *Lutzomyia* (*L.*) *longipalpis*  
(Fig. 15)

*Phlebotomus longipalpis* Lutz & Neiva, 1912: 90 (♂, ♀, Brazil, definite type locality not given). Barretto, 1947: 208 (full references). Guitton & Sherlock, 1969: 383 (immature stages).

*Lutzomyia longipalpis*: Osorno et al., 1969: 379 (redescr., ♂, ♀, Tolima Dept., Colombia), Osorno et al., 1972a: 17 (Colombian records). Forattini, 1973: 213 (gen. review, figs.). Lewis, 1975a: 500 (mouth-part morphol.). Killick-Kendrick et al., 1977: 429 (rearing).

*Distribution:* Southern Mexico to central Argentina. *Colombia* (Caldas, Cundinamarca, Huila, Tolima).

*Material examined:* Colombia. 1 ♂, 2 ♀♀, Baraya (Huila), rock crevices, March 1945, M. Hertig. Venezuela. 7 ♂♂, 13 ♀♀, near Calabozo (Guarico), outside wall of house, 17 July 1965, D.G.Y. Bolivia, Brazil, Costa Rica, El Salvador, Mexico, & Paraguay. Numerous specimens from various localities within these countries.

*Discussion:* *Lutzomyia longipalpis*, first reported in Colombia by Osorno et al. (1969), has received much attention because of its role as a vector of kala-azar in the New World. It would be redundant to cite all important references to this species, the type species of the genus, because Forattini (1973) has recently reviewed most of them.

*Phlebotomus otamae* Nunez-Tovar, 1924, and *Phlebotomus almazani* Galliard, 1934, are well established junior synonyms of *L. longipalpis*.

#### Series *cruciata*

##### 15. *Lutzomyia* (L.) *gomezi* (Fig. 16)

*Phlebotomus gomezi* Nitzulescu, 1931: 247 (♀, San Cristobal, Tachira State, Venezuela). Barretto, 1947: 202 (full references). Fairchild & Hertig, 1948a: 252 (taxonomy). Fairchild & Hertig, 1953b: 382 (♂, ♀, redescr., refs., figs.). Hanson, 1968: 60 (larva & pupa). Barreto, 1969: 464 (Meta & Valle, Colombia). Morales et al., 1969a: 378 (Meta, Colombia).

*Phlebotomus suis* Rozeboom, 1940: 8 (♂, ♀, Panama). Barretto, 1946a: 1 (as synonym of *gomezi*). Fairchild & Hertig, 1948a: 252 (as synonym of *gomezi*).

*Phlebotomus japignyi* Floch & Abonnenc, 1944b: 2 (♂, ♀, French Guiana). Fairchild & Hertig, 1948a: 252 (as synonym of *gomezi*).

*Lutzomyia gomezi*: Martins et al., 1962b: 90 (cf. to *L. gaspar-viannai*). Osorno et al., 1972a: 19 (Colombian records). Forattini, 1973: 240 (gen. review). Lewis, 1975a: 500 (mouthpart morphol.). Interhill & Muller, 1976: 543 (Honduras). Miles et al., 1976: 531-532 (mating behavior). Ward & Ready, 1975: 128 (egg, figs.). Zimmerman et al., 1977: 575 (egg, figs.).

*Distribution*: El Salvador to southern Brazil. *Colombia* (Amazonas, Antioquia, Bolivar, Boyaca, Caldas, Caqueta, Cesar, Guajira, Huila, Magdalena, Meta, Norte de Santander, Santander, Tolima, Vichada).

*Material examined*: *Colombia*. 19 ♂♂, 14 ♀♀, Curiche (Choco), Malaise trap, May-Nov. 1967, D.G.Y. 23 ♀♀, same data but biting man. 2 ♂♂, same data but on tree trunk, 4 April 1967. 1 ♀, Sautata, Rio Atrato (Choco), Malaise trap, 20 Jan. 1968, D.G.Y. 8 ♂♂, 3 ♀♀, Rio Anori (Antioquia), light traps, May 1970, C.H.P. 1 ♀, same data by 15 Sept. 1970, D.G.Y. 7 ♀♀, Puerto Boyaca (Boyaca), light trap, 6 May 1973, C.J.M. 6 ♂♂, 2 ♀♀, Tres Esquinas (Caqueta), light trap, 10 Nov. 1971, C.J.M. 1 ♂, 17 km W of Leticia (Amazonas), light trap, 26 July 1973, D.G.Y. & R.C.M. *Brazil, Costa Rica, Ecuador, Nicaragua, Panama, Venezuela*. Numerous specimens on slides and in alcohol, in collection at UF.

*Discussion*: *Lutzomyia gomezi*, a widespread species in Colombia and elsewhere, is highly anthropophilic. Some of the many man-biting records include those from Panama (Fairchild and Hertig, 1948a; Chaniotis et al., 1971b), Colombia (Osorno et al., 1972a), Venezuela (Pifano and Ortiz, 1965), Trinidad (Callan, 1947, as *trinidadensis*), and Brazil (Ward et al., 1973). In Panama, Chaniotis et al. (1971b) observed that females were more commonly taken in the canopy than at ground level in human biting collections. This species is one of the suspected vectors of

dermal leishmaniasis in that country (Schneider and Hertig, 1966; Christensen and Herrer, 1973).

Forattini (1973) provides additional references and information on the biology and disease relationships of *L. gomezi*.

16. *Lutzomyia* (*L.*) *marinzelei* n. sp.  
(Fig. 17)

*Male*: Wing length 1.7; width 0.42. Head, mesonotum, abdominal tergites, and genitalia strongly pigmented; rest of insect, including most of pleura, moderately pigmented. Head height 0.34; width 0.33. Eyes large, separated by 0.09 or by distance = to 5.3 facet diameters. Flagellomere I (0.33 long), 1.1 x length of II + III; ascoids with very short posterior spurs, their distal tips ending before apical third of flagellomere II, on all flagellomeres except last 2. Length of palpal segments: 1 (0.04), 2 (0.12), 3 (0.15), 4 (0.12), 5 (0.32); palpal sensilla, fewer than 10, on middle third of segment 3. Labrum length 0.195. Cibarium unarmed except for vestiges of vertical teeth; chitinous arch complete, diffuse in middle; pigment patch subtriangular, more narrow than  $\varphi$ . Pharynx length 0.146. Pleura with 19 upper and 5 lower episternal setae. Length of wing vein sections: *Alpha* (0.30), *beta* (0.21), *delta* (0.07), *gamma* (0.30). Legs missing but length of femora, tibiae, and basitarsi of paratype no. 631: Foreleg, 0.71, 0.70, 0.39; midleg, 0.71, 0.93, 0.46; hindleg, 0.74, 0.98, 0.56. Abdominal sternite 2 horseshoe-shaped, the median opening not enclosed. Style short (0.13 long) with 4 strong spines as shown, no subterminal bristle. Coxite stout (0.25 long x 0.10 wide at greatest width), basal tuft of 12-13 long setae on individual tubercles which form a raspberry-like base. Paramere

as shown, upturned apically, dorsal setae few and rather short, these and lateral setae restricted to apical third of structure, ventral setae on distal half. Aedeagus (ca. 0.11 long) slender apically. Lateral lobe (0.28 long), wider distally, perhaps due to mounting. Genital pump (0.126 long); each filament ca. 0.43 long or 3.4 x length of pump, tip simple, not significantly enlarged. Cercus as shown.

*Female*: Wing length 1.85; width 0.57. Coloration same as ♂. Head height 0.38, width 0.37. Eyes large, separated by 0.98 or distance = to 5.5 facet diameters. Flagellomere I (0.28 long), 1.2 x length of II + III; ascoids with short posterior spurs, longer than those of ♂ but not reaching end of flagellomere II, last 7 flagellomeres missing. Length of palpal segments: 1 (0.04), 2 (0.13), 3 (0.16), 4 (0.10), 5 (missing); palpal sensilla as in ♂. Labrum length 0.23. Cibarium with 4 sharp horizontal teeth, 11-15 small vertical teeth in a single row; chitinous arch complete, diffuse in middle; pigment patch as shown, darker and wider posteriorally. Pharynx length 0.17. Pleura with 19 upper and 7 lower episternal setae. Length of wing vein sections: *Alpha* (0.44), *beta* (0.25), *delta* (0.11), *gamma* (0.30). Length of femora, tibiae, and basitarsi of slide 632: Foreleg, 0.78, 0.71, 0.39; midleg, 0.75, 0.90, 0.46; hindleg, 0.83, 1.1, 0.56. Abdominal sternite 2 apparently open in middle as in ♂ but hardly noticeable. Tergite 8 lacking setae. Tergite 9 without dorsolateral papillate lobes. Spermathecae, sperm ducts and cerci as shown.

*Material examined*: *Colombia*. ♂ holotype (no. 628), Tres Esquinas (Caqueta), light trap, 10 Nov. 1971, C.J. Marinkelle. ♀ allotype (no. 629), same data. 1 ♂, 1 ♀ paratypes (no. 630, 633) same data. *Brazil*. 1 ♂, 1 ♀ paratypes (nos. 631-632), near Rio Aripuana (Mato Grosso), J. Arias.

*Discussion:* *Lutzomyia marinkellei* is closely allied with *L. cruciata* (Coq.), *L. evangelistai* Martins and Fraiha, *L. gomezi*, and *L. sherlocki* Martins, Silva, and Falcão, all of which form the series *cruciata*. From these, the male of *marinkellei* is separated by the following combination of characters: Both mesonotum and pleura infuscated. Style short, its length less than or equal to half the length of lateral lobe. Paramere with few dorsal setae, these and lateral setae confined to apical third of structure. Coxite tuft of fewer than 20 setae.

The dark pleura differentiates the female from *evangelistai*, *gomezi*, and *sherlocki* -- species with pale pleura which are (or may be sympatric with *marinkellei*. The status of *L. cruciata* and the form described as *Phlebotomus diabolicus* Hall is still uncertain but the latter taxon is probably a subspecies of *cruciata* as treated by Lewis (1975a). The females of *marinkellei* and *c. diabolica*, unlike *c. cruciata*, lack papillate lobes of tergite 9 and have well pigmented pleura. It would be difficult to separate these females in the absence of males were it not for the fact that *c. diabolica* occurs well outside the range of *marinkellei* in Mexico and Texas.

The length of the first flagellomere, the character used in the key to separate *marinkellei* from females of *lichyi* and *bifoliata*, may prove to be variable as a diagnostic character. With these taxa specific identification should be based on associated males.

I am pleased to name this species after Dr. C.J. Marinkelle who was most helpful in providing material for this study.

Figure 13

*Eutzomyia (L.) bifoliata* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Dorsal arm of paramere, G. Genital pump and filaments, H. Male genitalia, I. Spermathecae, J. Female wing, K. Male wing, L. Female cibarium.

Male: Rio Anori, Antioquia Dept., Colombia

Female: Same locality as male

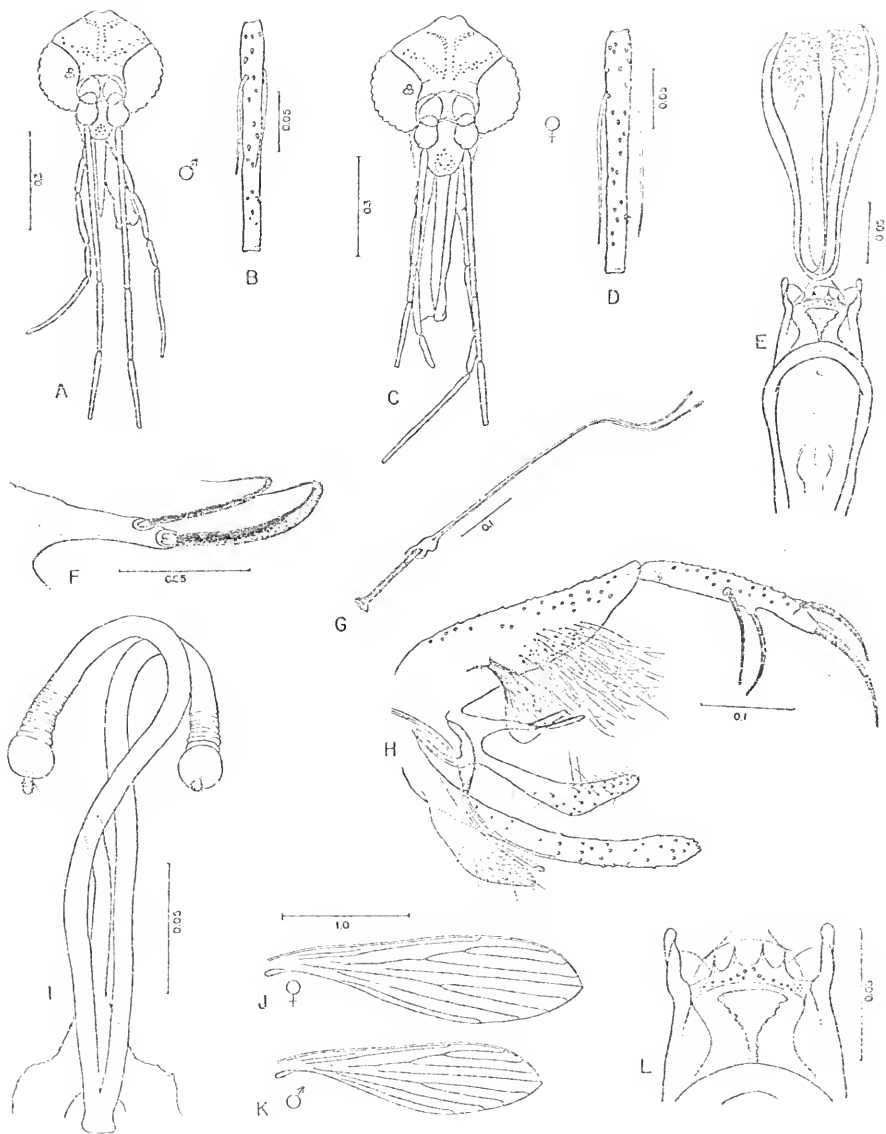




Figure 14

*Lutzomyia (L.) lichyi* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Spermathecae, G. Female cibarium, H. Female wing, I. Male wing, J. Male genitalia.

Male: Alto Curiche, Choco Dept., Colombia

Female: Curiche, Choco Dept., Colombia

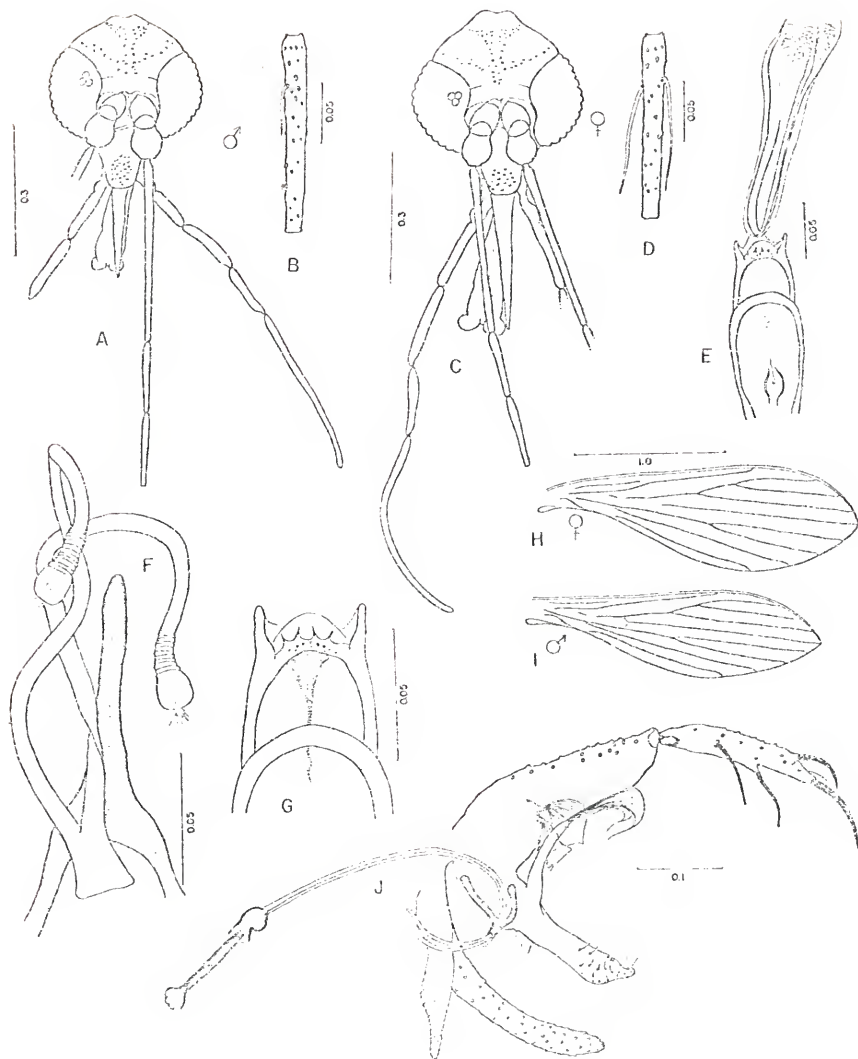


Figure 15

*Lutzomyia (L.) longipalpis* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Female wing, G. Male wing, H. Genital pump and filaments, I. Male genitalia, J. Body of spermatheca, K. Spermathecae, L. Genital pump, same scale as Fig. 15I, M. Paramere of male from Huila Dept., Colombia, same scale as Fig. 15I, N. Female cibarium.

Male: Calabozo, Guarico State, Venezuela

Female: Same locality as male (except for Fig. 15M)

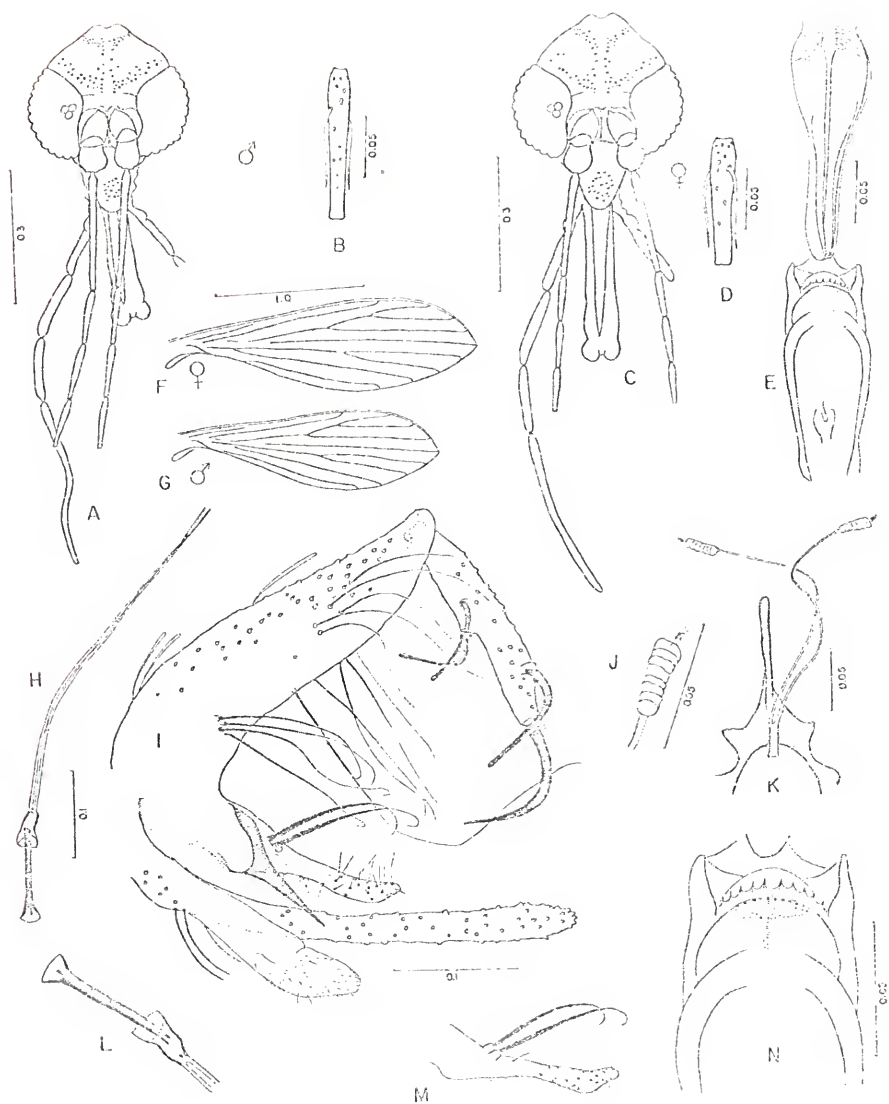


Figure 16

*Lutzomyia (L.) gomezi* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, G. Spermathecae, H. Female wing, I. Male wing, J. Female cibarium.

Male: Trinidad

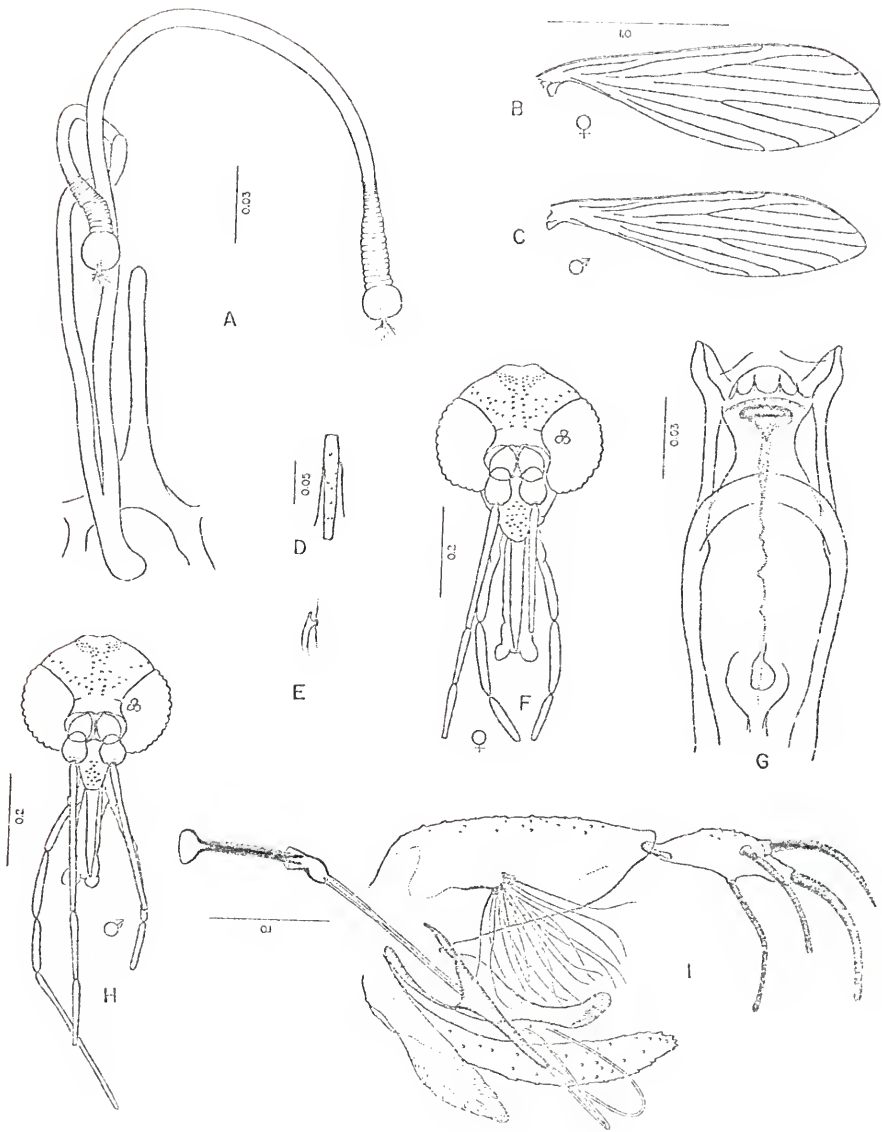
Female: Trinidad

Figure 17

*Lutzomyia (L.) marinkellei* -- A. Spermathecae, B. Female wing, C. Male wing, D. Female flagellomere II, E. Base of ascoid, F. Female head, G. Female cibarium, H. Male head, I. Male genitalia.

Male: Tres Esquinas, Caqueta Dept., Colombia

Female: Rio Aripuana, Mato Grosso State, Brazil



Migonei Group Theodor, 1965

This group is divided into 3 series following Lewis et al. (1978). The series *migonei*, *walkeri*, and *coastalimai* (= subgenus *Barrettomyia* Martins and Silva, 1965). Species in the latter series occur in Brazil but some of those in the other series are more widespread with 4 species occurring in Colombia. Barretto (1962) and Forattini (1971a, 1973) include some of the *migonei* group taxa in the subgenus *Coromyia* Barretto, 1962.

Based on present knowledge, the only man-biting species in this group is *I. migonei*, here reported in Colombia for the first time.

Keys to Species

Males

1. Genital filaments over 3 x length of pump, with simple tips. Coxite with basal tuft of 4-6 short setae . . . . . *migonei* (Fig. 18)

Genital filaments less than 3 x length of pump, their tips spherically enlarged with an inner "tooth." Coxite with basal tuft of 10+ longer setae and a median ventral group of 6+ setae . . . . . 2

2. Aedeagus simple, without a dorsal projection. Genital filaments 0.30 mm or longer. . . . . *marajoensis* (Fig. 19)

Aedeagus complex, with a dorsal cylindrical projection. Genital filaments less than 0.30 mm. . . . . *walkeri* (Fig. 20)



females

1. Spermathecae narrow and tubular, at least 3 x longer than wide. . .  
 . . . . . *nigonei* (Fig. 18)  
  
Spermathecae capsule-shaped, less than 2 x as long as wide. . . . . 2
2. Individual sperm ducts over 3 x length of common duct, wider and with  
fine transverse striations basally. . . . . sp. de Baduel (Fig. 18)  
  
Individual sperm ducts about 1/2 as wide as common duct . . . . .  
 . . . . . *marajoensis* (Fig. 19)  
  
Individual sperm ducts more slender, about 1/3 as wide as common  
duct. . . . . *walkeri* (Fig. 20)

Series *migonei*

17. *Lutzomyia migonei*  
(Fig. 18)

*Phlebotomus migonei* França, 1920: 230 (♂ holotype, Assuncion, Paraguay). Barretto, 1947: 211-213 (full refs., synonyms). Forattini, 1954: 214 et seq. (sternites, figs.). Forattini, 1960: 479 (Amapa, Brazil). Pifano et al., 1962: 387, 388 (♂, ♀, keyed). Calderon, 1973: 87 (Merida State, Venezuela).

*Lutzomyia migonei*: Theodor, 1965: 182 (♂, ♀, figs.). Forattini, 1973: 122 et seq. (gen. review, refs., immatures, figs.). Lewis, 1975a: 500 et seq. (mouthpart morphol.).

*Distribution*: Colombia (Magdalena), Venezuela, Trinidad, Brazil, Paraguay, Argentina.

*Material examined:* Colombia. 2 ♂♂, Rio Don Diego, E of Santa Marta (Magdalena), tree trunks, 15 Aug. 1973, D.G.Y. & R.C.W. Brazil. 2 ♂♂, Lophina (Minas Gerais), flight trap near cave, 28 Aug. 1974, D.G.Y. & P. Williams. Trinidad. 2 ♂♂, Bush Bush Forest, Nariva Swamp, chicken-baited trap, 17-18 May 1961, T.H.G. Aitken. 1 ♀, same data but 22-23 May.

*Discussion:* Ranging from Argentina to northern Colombia, *L. migonei* has been found naturally infected with flagellates of uncertain identity in Venezuela and Brazil (Johnson et al., 1963; Forattini, 1973).

Other information dealing with the biology of this anthropophilic species was reviewed by Forattini (1973) and need not be repeated here.

*Series walkeri*

18. *Lutzomyia marajoensis*  
(Fig. 19)

*Phlebotomus marajoensis* Damasceno & Causey, 1944: 339 (♂ holotype, Ilha do Marajo, Brazil). Fairchild & Hertig, 1961b: 250-254 (♂, ♀, redescri., figs., refs., distrib.). Pifano et al., 1962: 386 et seq. (♂, ♀, redescri., figs., keyed). Sherlock, 1962: 327-328 (cf. to *dubitans*).

*Lutzomyia marajoensis*: Barretto, 1962: 98 (listed). Martins et al., 1962a: 381 (Goias, Brazil). Martins et al., 1963: 334 (Roraima, Brazil). Lewis, 1967b: 132 (refs., cf. to *walkeri*). Barreto, 1969: 461, 469 (mention). Forattini, 1971a: 101 (listed). Osorno et al., 1972a: 23 (Colombian records). Christensen, 1972a: 88 (listed). Forattini, 1973: 292 (as synonym of *walkeri*). Llanos, 1973: 31 (♂, ♀, redescri., figs., Peru). Christensen & Herrero, 1973: 579 (Panama record). Lewis, 1975a: 500 et seq. (mouthpart morphol.).

*Phlebotomus dubitans* Sherlock, 1962: 324 (♂ holotype, San Vicente de Chucuri, Santander, Colombia). Osorno et al., 1967: 28 (mention).

*Lutzomyia dubitans*: Theodor, 1965: 182 (listed). Lewis, 1967b: 131 (mention). Forattini, 1971a: 103 (listed). Osorno et al., 1972a: 23, 78 (mention). Martins & Morales, 1972: 366 (listed). Forattini, 1973: 292 (as synonym of *walkeri* and *marajoensis*).

*Distribution*: Panama, Colombia (Boyaca, Huila, Santander), Brazil, Venezuela, Trinidad.

*Material examined*: Colombia. 1 ♂, Soledad, San Vicente de Chucuri (Santander), chicken coop, 16 Aug. 1944, A. Gast, E. Osorno, & O. Mangabeira. Panama, Venezuela, and Trinidad, those specimens listed by Fairchild & Hertig (1961b).

*Discussion*: A *L. marajoensis* male, the one listed by Fairchild and Hertig (1961b) from San Vicente de Chucuri, Santander, Colombia, was given to Gorgas Memorial Laboratory by Dr. O. Mangabeira in the 1940's (Dr. G.B. Fairchild, pers. comm.). With some reservations, Sherlock (1962) later described *L. dubitans* based on other males taken at the same time and place as this male. Forattini (1973) treated both *dubitans* and *marajoensis* as junior synonyms of *L. walkeri* but only the first two are conspecific, the latter species being easily separated from *marajoensis* by the characteristics given in the key and by the shape of the parameres (cf. Figs. 19G and 20C).

Although *L. walkeri* appears to be more widely distributed than *marajoensis*, both species occur together in some localities in Colombia and Trinidad.

19. *Lutzomyia* sp. de Baduel  
(Fig. 18)

*Phlebotomus* sp. de Baduel Floch & Abonnenc, 1945b: 1 (♀, Baduel, French Guiana). Floch & Abonnenc, 1945c: 12 (♀ keyed). Floch & Abonnenc, 1952: 21 et seq. (♀, keyed, redescr., figs.). Forattini, 1960: 480 (Amapa, Brazil).

*Lutzomyia* sp. de Baduel: Theodor, 1965: 196 (listed). Martins et al., 1965: 4 (Rondonia & Maranhao, Brazil). Osorno et al., 1972a: 66 (Vichada, Colombia).

*Distribution:* Colombia (Vichada), Brazil, French Guiana.

*Material examined:* Colombia. 1 ♀ (no. 652 INPES), Cumariana (Vichada), light trap, 15 May 1967, C.J.M.

*Discussion.* The male of this informally named taxon remains unknown but it is certainly possible that it may be conspecific with one of the described males in the series, possibly *L. sericea* (Floch and Abonnenc) or *L. williamsi* (Damasceno, Causey, and Arouck).

The single known female from Colombia, seen by me, compares favorably with the description and figures given by Floch and Abonnenc (1945b, 1952). I have no reservations about placing it in the series *walkeri* of the *migonei* group based on spermathecae, cibarial structure, and palpi.

20. *Lutzomyia walkeri*  
(Fig. 20)

*Phlebotomus walkeri* Newstead, 1914: 188 (♂, ♀, Rio Abuna, Bolivia-Brazil boundary). Barretto, 1947: 230 (full refs.). Fairchild & Hertig, 1961b: 250, 254 (cf. to *marajoensis*).

*Lutzomyia walkeri*: Barretto, 1962: 98 (listed). Martins et al., 1965: 4 (Rondonia, Brazil). Lewis, 1967b: 132 et seq. (♂, ♀, redescr., figs.). Forattini, 1971a: 101 (listed). Osorno et al., 1972a: 23 (Colombian records). Llanos, 1973: 31 (♂, ♀, redescr., figs.). Forattini, 1973: 274 et seq. (in part, gen. review, figs.). Lewis, 1975a: 500 et seq. (mouthpart morphol.). Llanos et al., 1975b: 671 (Peru).

*Phlebotomus gasti* Sherlock, 1962: 326 (♂, San Vicente de Chucuri, Santander, Colombia). Osorno et al., 1967: 28 (mention). *NEW SYNONYM.*

*Lutzomyia gasti*: Theodor, 1965: 182 (listed). Lewis, 1967b: 131 (listed). Forattini, 1971: 103 (listed). Christensen, 1972a: 88-89 (Panama). Osorno et al., 1972a: 23 (Colombian records). Forattini, 1973: 348 et seq. (gen. review, fig.).

*Distribution*: Panama, Colombia (Antioquia, Caqueta, Santander), Ecuador, Peru, Brazil, Trinidad.

*Material examined*: Colombia. 1 ♂ (no. 3924 INPES), La Nevera, Solano (Caqueta), tree hole, 25 June 1969, A. Gast & J. Ochoa. 3 ♀♀, Tres Esquinas (Caqueta), light trap, 10 Nov. 1971, C.J.M. 1 ♂, labelled *P. gasti* Mang. MS, no. 1120, Colombia (probably from the type locality of *gasti*). Brazil. 1 ♂ from type series, Abuna River, Bolivia-Brazil boundary, Dr. F.D. Walker, the Elders, Brixham, S. Devon. 2 ♂♂, Labrea (Amazonas), tree trunk, 9 Oct. 1972. D.G.Y. 1 ♂, 1 ♀, same data but light trap, 10 Oct. 1972. Ecuador. 1 ♀, Rio Napo at Limoncocha (Napo), flight trap, 22 May 1976, D.G.Y. & T. Rogers. Trinidad. 150+ specimens of both sexes from various localities to be discussed in a forthcoming paper.

*Discussion*: Both Lewis (1967b) and Llanos (1973) carefully re-described the male and female of *L. walkeri*, the former author studying

material from the type series; the latter basing her description on Peruvian specimens. I remounted a male from the type series, the one mentioned by Lewis (op. cit.), as being in the collection at Gorgas Memorial Laboratory but which is now at the University of Florida. I also examined a male from Santander Dept., Colombia which Mangabeira collected and which bears the name *P. gasti* MS. These two males are identical in all aspects including the presence of the dorsal projection of the aedeagus as figured by Sherlock (1962) for *L. gasti* and by Llanos (op. cit.) for *L. walkeri*. I am convinced therefore that *L. gasti* is a junior synonym of *L. walkeri*. I should point out that the dorsal projection of the aedeagus is lightly sclerotized, less so than Sherlock (1962) depicts, and this probably is the reason why Lewis (op. cit.) did not observe this character state in the specimens at the British Museum (Nat. Hist.).

I consider the Ecuadorian female to be conspecific with *walkeri* based on morphology and distribution.

Figure 18

*Lutzomyia migonei* -- A. Male genitalia, B. Female cibarium, C. Spermathecae.

Male: Trinidad  
Female: Trinidad

*Lutzomyia* sp. de Baduel female -- D. Cibarium, E. Spermathecae.

Female: Cumariana, Vichada Comisaria, Colombia

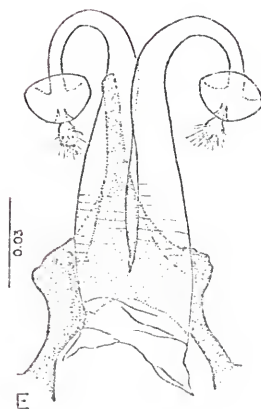
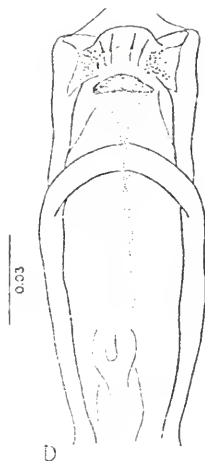
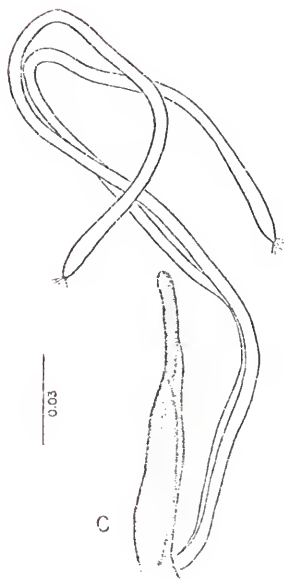
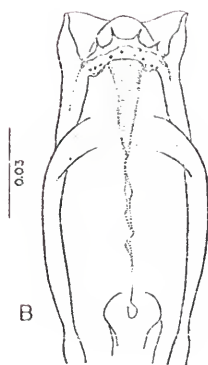
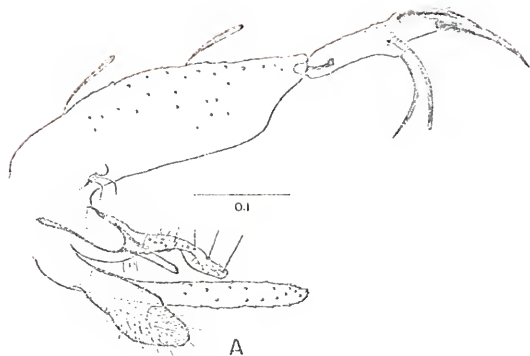




Figure 19

*Lutzomyia marajoensis* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Body of spermatheca, G. Male genitalia, H. Genital pump, I. Genital pump and filaments, J. Tips of genital filaments, K. Spermathecae, L. Female wing, M. Male wing, N. Female cibarium.

Male: San Jose, Los Santos Prov., Panama

Female: Puerto Mensabe, Los Santos Prov., Panama

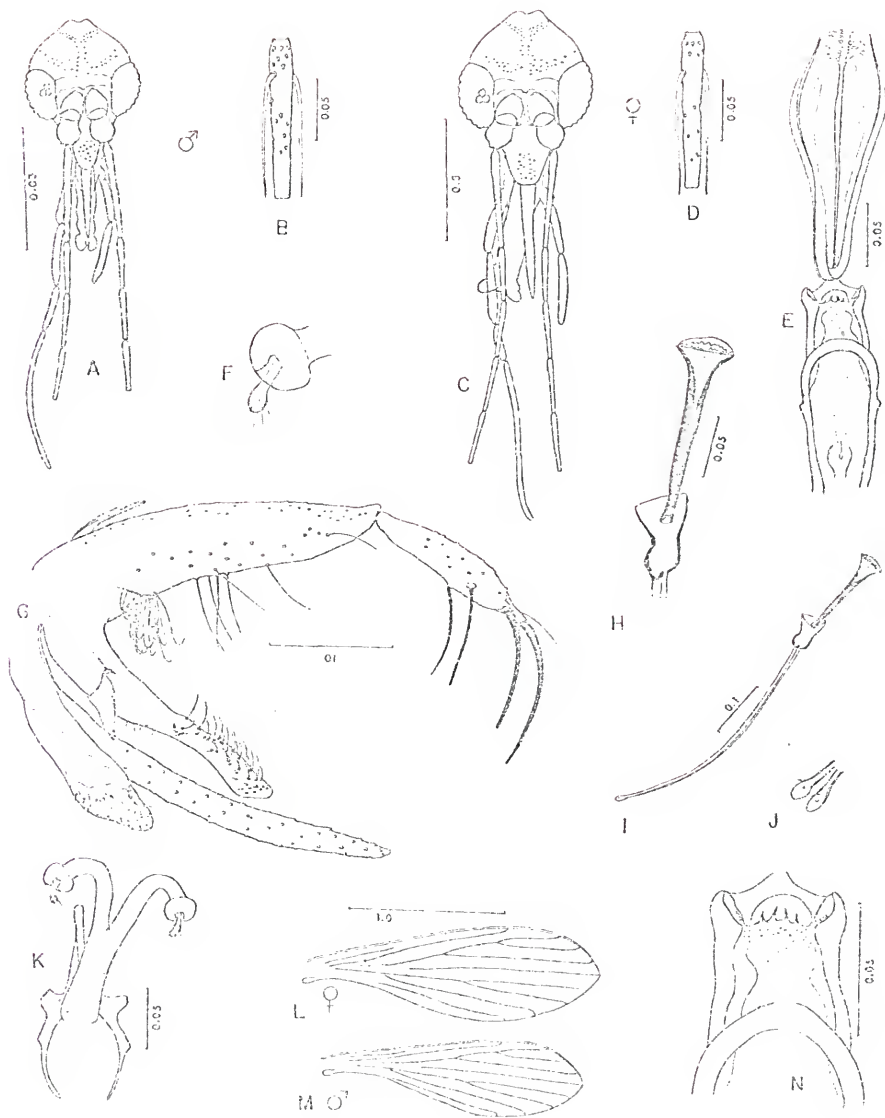
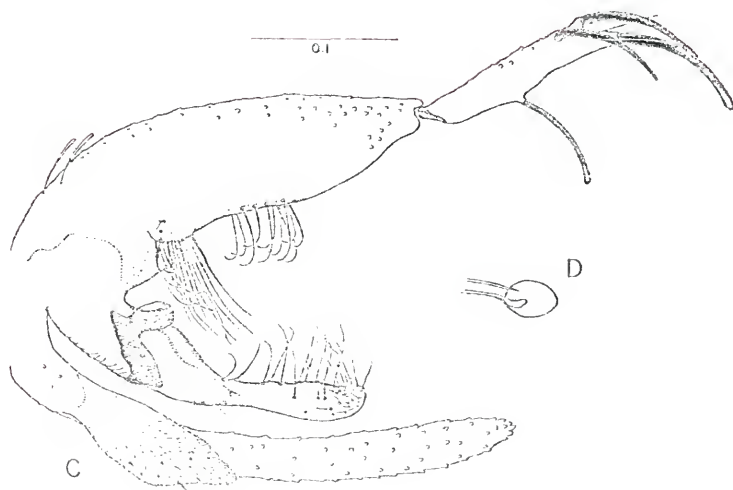
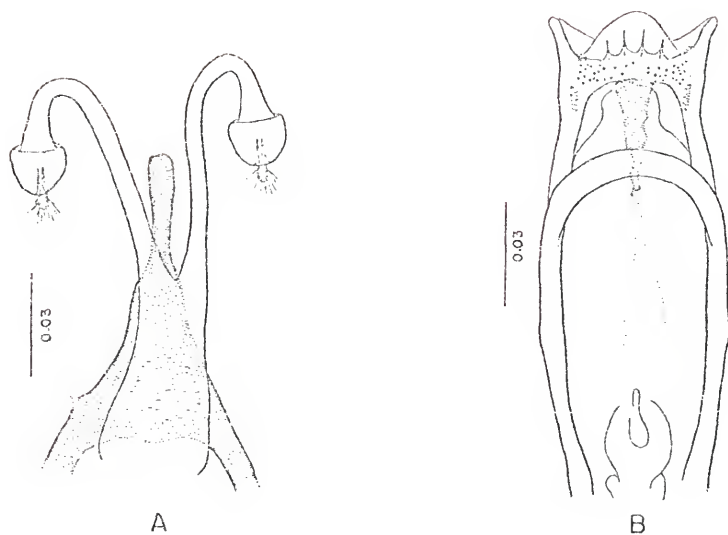


Figure 20

*Lutzomyia walkeri* -- A. Spermathecae, B. Female cibarium, C. Male genitalia, D. Tip of genital filament, greatly enlarged.

Male: Trinidad

Female: Trinidad



Saulcrsis Group Lewis et al., 1978

This group was created to accomodate two closely related species -- *L. saulensis* and *L. wilsoni* (Damasceno and Causey). Forattini (1971a, 1973) places the former species in the subgenus *Dampfomyia* Addis but the spermathecae are structurally different (Theodor, 1965), the male parameres lack a dorsal arm, and the style has no subterminal bristle.

The females of *saulensis* and *wilsoni* are nearly identical (Vianna Martins, pers. comm.), their populations probably overlapping in northern Brazil.

21. *Lutzomyia saulensis*  
(Fig. 21)

*Phlebotomus saulensis* Floch & Abonnenc, 1944a: 11 (♂ holotype, Saul, Haute Mana, French Guiana). Barretto, 1947: 222 (listed). Damasceno et al., 1948: 831 (Brazilian records). Floch & Abonnenc, 1952: 35, 112-114 (♂ keyed, redescri., figs.). Fairchild & Hertig, 1958b: 204-205 (refs., taxonomic discussion). Fairchild & Hertig, 1959: 122 (distrib.). Sherlock, 1962: 321, 330 (Santander, Colombia). Pifano et al., 1962: 386, 389 (♂, ♀, keyed, Venezuela). Osorno et al., 1967: 28 (mention).

*Phlebotomus pinealis* Floch & Abonnenc, 1944a: 11 (♀ holotype, Crique Anguille, French Guiana). Fairchild & Hertig, 1958b: 204-205 (refs. as synonym of *saulensis*). Johnson & Hertig, 1961: 765, 774 (rearing attempt). Hanson, 1968: 69 (1st instar larva, descr., fig.).

*Lutzomyia saulensis*: Martins et al., 1963: 335 (Roraima, Brazil). Martins et al., 1965: 3 (Rondonia, Brazil). Theodor, 1965: 196 (♂, ♀, figs.). Barreto, 1969: 466-467 (Valle, Colombia). Lewis et al., 1970: 215 (parous study). Fraiha et al., 1970b: 215 (mention).

Christensen & Fairchild, 1971: 301 (Panama), Chaniotis et al., 1971a: 344 et seq. (pop. dynamics, Panama). Osorno et al., 1972a: 66 (Colombian records). Christensen, 1972a: 88 (listed). Chaniotis et al., 1972: 95 et seq. (resting sites). Shaw & Lainson, 1972: 710 et seq. (infected with nonleishmanial flagellates, collecting data, Brazil). Llanos, 1973: 34 (♂, ♀, redescr., figs., Peru). Forattini, 1973: 327 et seq. (gen. review, figs.). Christensen & Herrer, 1973: 579 (listed). Ward et al., 1973: 178 (attracted to rodents and man, Brazil). Lainson et al., 1973: 190 (negative for *Leishmania*). Lewis, 1975a: 504 et seq. (mouthpart morphol.). Llanos et al., 1975b: 671 (Peru). Llanos et al., 1976: 480 (Peru). Martins et al., 1976b: 496 (Peru).

*Distribution:* Costa Rica, Panama, Colombia (Antioquia, Caqueta, Choco, Santander, Valle), Peru, Brazil, French Guiana.

*Material examined:* Colombia. 2 ♀♀, Rio Anori (Antioquia), light traps, 3 May 1970, C.H.P. 8 ♂♂, 11 ♀♀, same data but some in tree hollows, Sept. 1970. D.G.Y. 14 ♂♂, 55 ♀♀, Curiche (Choco), light, Shannon & Malaise traps, tree trunks, May-Dec. 1967, D.G.Y. 3 ♀♀, Alto Curiche (Choco), Malaise & light traps, Aug., Spet., Nov. 1967, D.G.Y. 1 ♀, Teresita (Choco), Malaise trap, 22 April 1967, D.G.Y. 4 ♀♀, Rio Atrato at Sautata (Choco), Malaise traps, Nov.-Dec. 1967, Jan. 1968, D.G.Y. 2 ♂♂, Anchicaya Dam (Valle), tree trunks, 9 Aug. 1973, D.G.Y. & R.C.W. 1 ♂, same data but light trap, 10 Aug. 1973. 2 ♀♀, 25 km E of Buenaventura (Valle), flight trap, 12 Aug. 1973, D.G.Y. & R.C.W. Brazil. 1 ♂, Belem (Para), 1 Feb. 1944, R. Damasceno & O. Causey.

*Discussion:* Although widely distributed in lowland forests, *L. saulensis* is a little known species. Ward et al. (1973) collected

specimens on rodent and human bait in Para, Brazil, but this species can not be regarded as being anthropophilic. Both sexes are readily identifiable.

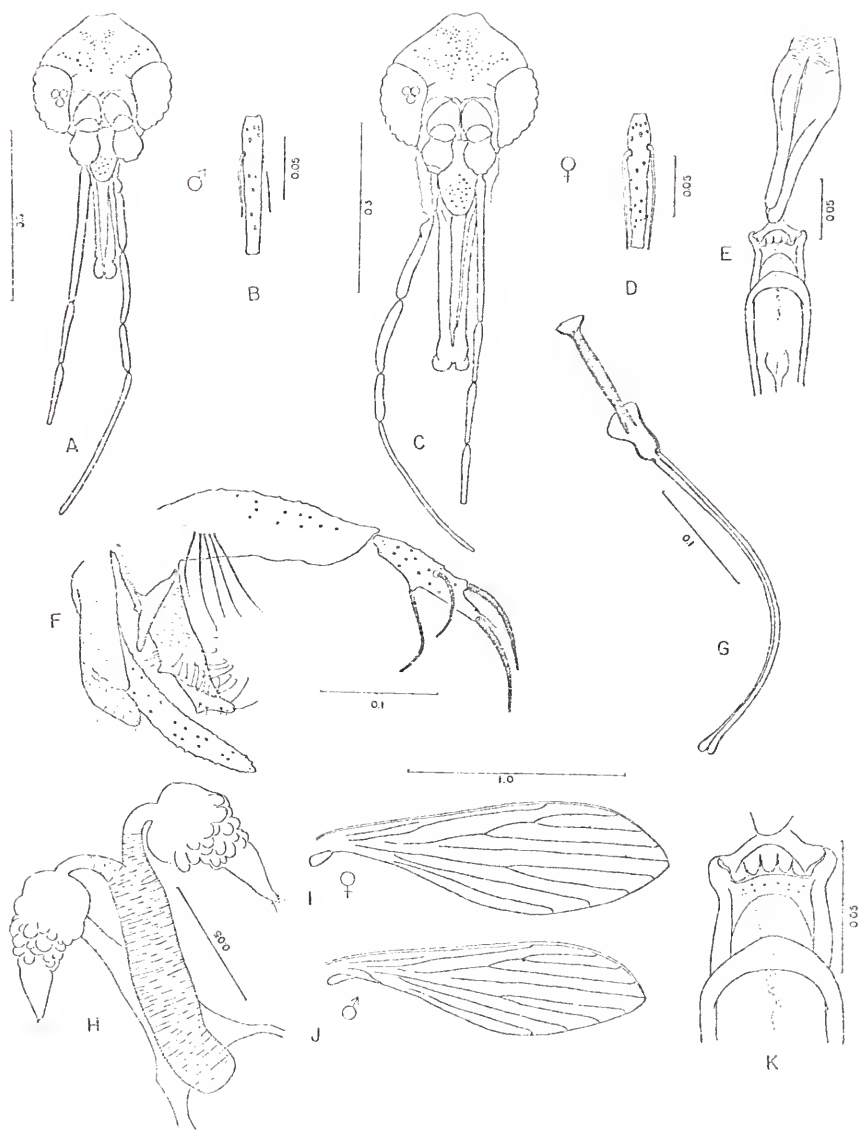
Figure 21

*Lutzomyia saulensis* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, G. Genital pump and filaments, H. Spermathecae, I. Female wing, J. Male wing, K. Female cibarium.

Male: Curiche, Choco Dept., Colombia

Female: Same locality as male





Verrucarum Group Theodor, 1965

This group of 22 species is divided into 2 series based on male characteristics (Theodor, 1965) -- the series *verrucarum* (14 spp.) and the series *serrana* (7 spp.). At present, *L. bursiformis* (Floch & Abonnenc) from French Guiana cannot be placed because the male remains undiscovered. Some authors include these species in the subgenus *Lutzomyia* Franca (Forattini, 1971a, 1973) or in the subgenus *Coromyia* Barretto, 1962.

Two species in the series *serrana* and 11 in the series *verrucarum* occur within or very near the borders of Colombia. The majority of species in the latter series are Andean, although *L. ovallesi* and *L. evansi* are widespread in lowland areas. The Andean taxa are morphologically similar and for the most part have limited, allopatric distributions.

Unfortunately, the females of most species are difficult, if not impossible, to identify without associated males. For this reason I am omitting keys to the females but will point out, when possible, the distinguishing characteristics for some of the species. It may be appropriate to add that the presence of *L. verrucarum* (Townsend) in Venezuela (Anduze et al., 1947; Floch and Abonnenc, 1950a; Forattini, 1973) can be confirmed only when the male is discovered in that country.

Key to Species

Males

1. Style of male genitalia with 2 or 3 strong spines (series *serrana*). 2
- Style with 4 strong spines (series *verrucarum*). . . . . 3

2. Coxite tuft of 5-6 setae, upturned but not strongly recurved at tips,  
implanted in a straight row . . . . . *serrana* (Fig. 22)
  
- Coxite tuft of 6-7 setae, markedly recurved apically, not implanted  
in a straight row . . . . . *odax* (Fig. 28)
  
3. Basal spine of style isolated . . . . . 4
  
- Basal spines of style paired, inserted more or less on the same  
level . . . . . 7
  
4. Terminal spine of style very thick and crooked. Paramere as in  
Fig. 28E. . . . . *spinicrassa* (Fig. 28)
  
- Terminal spine of style relatively slender, not crooked. Paramere  
otherwise . . . . . 5
  
5. Middle third of paramere with dorsal and ventral setae. . . . .
  
- . . . . . *sauroida* (Fig. 28)
  
- Middle third of paramere without dorsal or ventral setae. . . . . 6
  
6. Paramere club-like, angular at tip and with dorsal subspical row of  
13-16 short spine-like setae. . . . . *longiflocosa* (Fig. 28)
  
- Paramere more or less rounded at end, less club-like, dorsal subapical  
setae longer, not spine-like. . . . . *quasitownsendi* (Fig. 28)
  
7. Coxite with subapical group of long hairs. Basal spines of style in-  
serted on well marked rather long tubercles . . . . . 8
  
- Coxite without subapical group of long hairs. Basal spines of style  
not implanted on tubercles. . . . . 9

8. Setae of basal coxite tuft thicker. Paramere as shown, with distal lobe on the ventral margin and with dorsal setae confined to extreme tip. Style with simple basal spines, no subterminal bristle. . . . . *moralesi* n. sp. (Fig. 26)
- Setae of basal coxite tuft slender. Paramere more clubbed at end, without ventral lobe but with numerous dorsal setae in a subapical patch. Style with shorter basal spine modified as shown, subterminal bristle present . . . . . *andina* (Fig. 23)
9. Dorsal setae of paramere restricted to distal third of structure. .10
- Dorsal setae of paramere covering at least distal half of structure . . . . . .11
10. Paramere strongly clubbed. Coxite tuft of 10+ setae. Flagellomere I at least 20% longer than labrum . . . . . *columbiana* (Fig. 24)
- Paramere not clubbed. Coxite tuft of fewer than 7 setae. Flagellomere I short, subequal in length to labrum . . . . . *ovallesi* (Fig. 27)
11. Basal coxite tuft of 18+ setae. Distal third of paramere wider than middle third. . . . . *disiuncta* (Fig. 23)
- Basal coxite tuft of 10 or fewer setae. Distal third of paramere not enlarged. . . . . .12
12. Genital filaments over 4 x length of pump. Style with a subterminal seta. . . . . *evansi* (Fig. 25)
- Genital filaments less than 4 x length of pump. Style without a subterminal seta . . . . . *numentovari* (Fig. 23)

*Series serrana*

22. *Lutzomyia odax*  
(Fig. 28)

*Phlebotomus odax* Fairchild & Hertig, 1961b: 239 (♂ holotype, ♀, Almirante, Bocas del Toro, Panama).

*Lutzomyia odax*: Barretto, 1962, 97 (listed). Martins et al., 1965: 7 (cf. to *dubia*). Christensen & Fairchild, 1971: 302 (Darien, Panama). Christensen, 1972a: 88 (listed). Christensen et al., 1972: 57 (Panama). Forattini, 1973: 213 et seq. (gen. review, figs.).

*Distribution*: Guatemala, Honduras, Nicaragua, Panama.

*Material examined*: Panama. ♂ holotype (no. 4168), Almirante (Bocas del Toro), light trap, 15 Oct. 1952, A. Quinones. ♀ allotype (no. 3327), same data, but human bait collection, 20 June 1951, A. Vivanco. 1 ♂, same data but 17 June 1950, R. Hartmann.

*Discussion*: There is little doubt that this species occurs in Colombia, Christensen and Fairchild (1971) having reported its presence within 4 km of the Colombian border in Darien Province, Panama. Females closely resemble those of *L. serrana* but differ in the lengths of the individual sperm ducts (Fairchild & Hertig, 1961b). Both species occasionally bite man but are more common in light trap and resting collections.

Forattini (1973) may be correct in treating *L. dubia* Martins, Falcão, & Silva as a junior synonym of *L. odax* but more evidence is needed to support this view. Martins et al. (1965) point out differences between the taxa, especially those of the male genitalia.

23. *Lutzomyia serrana*  
(Fig. 22)

*Phlebotomus serranus* Damasceno & Arouck, 1949: 843 (♂ holotype, Serra da Piriabas, Para, Brazil). Forattini, 1960: 479 (Amapa, Brazil). Blancas, 1959-1960: 125 (Peru). Fairchild & Hertig, 1961b: 237 (refs., descr., figs.). Hanson, 1961: 320 (breeding sites). Johnson & Hertig, 1961: 765 (rearing data). Sherlock, 1962: 330 (Santander, Colombia). Rosebal, 1966: 1 (Costa Rica). Hanson, 1968: 76 (larva, pupa, descr.).

*Phlebotomus guayasi* Rodriguez, 1956: 76 (♂, ♀, Guayas, Ecuador). Fairchild & Hertig, 1961b: 237 (as synonym of *serranus*).

*Lutzomyia serrana*: Barretto, 1962: 97 (listed). Martins et al., 1965: 3 (Rondonia, Brazil), 6 (cf. to *dubia*). Lewis, 1967a: 74 (listed). Forattini, 1971a: 100 (listed). Tesh et al., 1971a: 152 (blood meals). Chaniotis et al., 1971a: 345 (pop. dynamics, Panama). Osorno et al., 1972a: 30 (Colombian records). Tesh et al., 1972: 90 (blood meals). Chaniotis et al., 1972: 95 (listed). Christensen, 1972a: 88 (listed). Forattini, 1973: 123 et seq. (gen. review, figs.). Llanos, 1973: 32 (Peru, figs.). Velasco, 1973: 77 (Bolivia). Llanos et al., 1975b: 668 (unusual spermathecae, fig.), 671 (Peru). Herrer & Christensen, 1976a: 62 (Panama). Llanos et al., 1976: 480 (Peru). Martins et al., 1976a: 488 (Peru). Martins et al., 1976b: 496 (Peru).

*Distribution*: Mexico, Honduras, Nicaragua, Costa Rica, Panama, Colombia (Antioquia, Bolivar, Boyaca, Caldas, Choco, Cundinamarca, Santander), Ecuador, Peru, Bolivia, Brazil.

*Material examined*: Colombia. 1 ♂, Alto Curiche (Choco), tree buttress, 21 May 1967, D.G.Y. 1 ♂, Rio Anori (Antioquia), tree buttress, 6 Feb. 1970, C.H.P. 1 ♀, same data but at light, 21 Sept. 1970, D.G.Y.

Panama. 1 ♂, 1 ♀, Rio Platanar (Panama), hollow tree, 20 July 1950,  
R. Hartmann.

*Discussion:* In Panama, Tesh et al. (1971a, 1972) identified the blood meals of 14 females using the precipitin test. Ten had fed upon rodents, 2 on edentates and 2 on marsupials. Dr. C.H. Porter (in litt.) collected less than 10 specimens on human bait over a one year period at Rio Anori (Antioquia), Colombia.

Series *verrucarum*

24. *Lutzomyia andina*  
(Fig. 23)

*Lutzomyia andina* Osorno, Osorno, & Morales, 1972b: 2 (♂ holotype, ♀, El Chariquito, Cundinamarca, Colombia). Osorno et al., 1972a: 24 (Colombian records).

*Phlebotomus verrucarum*: Osorno et al., 1967: 29 (not *verrucarum* Townsend).

*Distribution:* Colombia (Cundinamarca).

*Material examined:* 1 ♂, paratype, type locality, 2550 m above sea level, Aug. 1966. 1 ♀, paratype, same data but Sept. 1966.

*Discussion:* Specimens of this recently described species, known only from the type locality, were taken on human bait and in tree holes. Females bite man during the day and night.

The shorter of the paired basal spines of the male style is curiously modified, the apical part widened and with a flange (Fig. 23A). This characteristic, if shared by other *andina* males, will serve to separate it from other males in the *verrucarum* group.

25. *Lutzomyia columbiana*  
(Fig. 24)

*Phlebotomus columbianus* Ristorcelli & Van Ty, 1941: 263 (♀ holotype, Valle de Capuli, Narino, Colombia). Rozeboom, 1947b: 705 (♂, figs.). Sherlock, 1962: 322 (♂, ♀, figs.). Osorno et al., 1967: 28 (mention).

*Phlebotomus monticolus* var. *incanum* Ristorcelli & Van Ty, 1941: 266 (♀, Valle de Capuli, Narino, Colombia). Rozeboom, 1947b: 705 (as synonym of *columbiana*).

*Lutzomyia columbiana*: Barretto, 1962: 97 (listed). Osorno et al., 1972a: 24-26 (Colombian records). Forattini, 1973: 206 et seq. (gen. review, figs.).

*Distribution*: Colombia (Cauca, Guajira, Narino, Valle).

*Material examined*: Colombia. 5 ♂♂, 3 ♀♀, Bolivar (Cauca), Jan. 1944, J. Burbano. 1 ♂, 3 ♀♀, San Pedro (Narino), Jan. 1944, J. Burbano. 2 ♂♂, ca. 30 km NW of Cali, near El Carmen (Valle), tree trunks, 12 Aug. 1973, D.G.Y. & R.C.W.

*Discussion*: This precinctive Colombian species was the suspected vector of bartonellosis during the outbreak in southeastern Colombia over 40 years ago (Rozeboom, 1947b).

The record of *columbiana* from Montes de Oca and Serra Macuira in Guajira (Osorno et al., 1972a) is very interesting, these localities being widely separated from southeastern Colombia where *columbiana* was first discovered. The Andes, especially the eastern chain, may have acted as a corridor for the dispersal of this species.

I have seen other specimens of *columbiana* in the collections of the California Academy of Sciences and University of Florida. All were captured in southeastern Colombia and were identified by O. Mangabeira and P. Galindo.



26. *Lutzomyia disiuncta*  
(Fig. 23)

*Lutzomyia disiuncta* Morales, Osorno, & Osorno, 1974: 446 (♂ holotype, ♀, Hacienda La Conejera, Municip. de Suba, Bogota, Cundinamarca, Colombia).

*Distribution:* Colombia (Cesar, Cundinamarca).

*Material examined:* Colombia. 8 ♂♂, 21 ♀♀, Municip. Agustin Cadazzi (Cesar), Sept. 1969 (INPES). 3 ♂♂ (including holotype), 9 ♀♀, type locality, Aug.-Sept. 1969 (INPES).

*Discussion:* This is another Andean species which is anthropophilic, specimens having been taken on human bait during the day and night (Morales et al., 1974). Other specimens were captured in tree holes in Cesar Department.

27. *Lutzomyia evansi*  
(Fig. 25)

*Phlebotomus evansi*: Nunez-Tovar, 1924: 44 (♂, Mariara, Carabobo, Venezuela). Barretto, 1947: 198 (full refs.). Mirsa, 1953: (rearing data). Fairchild & Hertig, 1959: 122 (distrib.). Pifano et al., 1962: 412 (refs., redescrip., figs.). Rosabal & Trejos, 1964: 167 (El Salvador). Rosabal & Trejos, 1965: 222 (El Salvador). Osorno et al., 1967: 28 (Narino, Colombia).

*Lutzomyia evansi*: Theodor, 1965: 183 (listed). Morales et al., 1969b: 385 (mention). Osorno et al., 1972a: 27 (Colombian records). Llanos, 1973: 34 (♂, ♀ redescrip., figs., Peru). Forattini, 1973: 122 et seq. (gen. review, figs.). Llanos et al., 1975b: 670 (Peru).

*Distribution:* Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Colombia (Bolívar, Guajira, Magdalena, Narino, Santander), Peru, Venezuela.

*Material examined:* Colombia. 1 ♀, Arjona (Bolívar), 27 May 1940. 1 ♀, 10 km SE of Santa Marta (Magdalena), tree trunk, 17 Aug. 1973, D.G.Y. & R.C.W. Honduras: 30+ ♂♂, 100+ ♀♀, Chumbagua, Santa Barbara, light traps, July 1966, J. Matta. Other specimens from Central America and Venezuela in collection at UF.

*Discussion:* The female of *evansi* has very long sperm ducts and relatively small spermathecae (Fig. 25J), features which separate it from other *verrucarum* group females in Colombia. This species has been reported biting man in several countries including Colombia (Osorno et al., 1972a). It and *L. longipalpis* often, but not always, occur together in Central America, Colombia, and Venezuela. The apparent absence of this species from Panama is most peculiar.

28. *Lutzomyia longiflocosa*  
(Fig. 28)

*Lutzomyia longiflocosa* Osorno, Morales, Osorno, & Hoyos, 1970: 1 (♂ holotype, Municip. de Tello, Huila, Colombia. Osorno et al., 1972a: 28 (Colombian records). Osorno et al., 1972b: 18 (cf. to *andina* and *quasitownsendi*).

*Distribution:* Colombia (Huila).

*Material examined:* Colombia. 1 ♂ (paratype no. 1641), type locality, 9 Feb. 1968, E. Osorno et al.

*Discussion:* Other than resting in tree holes at the type locality, nothing is known about the habits of this species. The female is unknown.

29. *Lutnomyia moralesi* n. sp.  
(Fig. 26)

*Male*: Wing length 1.96; width 0.58. Head, mesonotum, and genitalia strongly pigmented, rest of insect pale. Head height 0.35; width 0.32. Eyes separated by 0.11 or by distance = to 5.9 facet diameters. Flagellomere I (0.33 long), 1.2 x length of II + III; ascoids simple, those on flagellomere II ending near middle of structure, on all flagellomeres except last. Length of palpal segments: 1 (0.04), 2 (0.15), 3 (0.16), 4 (0.11), 5 (0.32); palpal sensilla (ca. 10) grouped loosely at middle of segment 3. Labrum length 0.21. Cibarium with 30+ vestigial, dot-like teeth; chitinous arch complete, diffuse in middle; pigment patch invisible. Pharynx 0.15 long, unarmed. Pleura with 8-9 upper and 4 lower episternal setae. Length of wing vein sections: *Alpha* (0.53), *beta* (0.18), *delta* (0.17), *gamma* (0.32). Length of femora, tibiae, and basitarsi: Foreleg, 0.78, 0.90, 0.54; midleg, 0.74, 1.07, 0.61; hindleg 0.83, 1.22, 0.69. Abdominal sternites hardly visible some with lateral, circular openings. Genitalia: Style 0.13 long, shaped as shown, the proximal 2 spines inserted at the same level, the longer on a long process, no subterminal seta. Coxite (0.32 long x 0.12 wide) with a distal patch of 30+ straight or nearly straight setae, a dense tuft of ca. 30 thick sinuous setae at base. Paramere as shown but variable according to angle of view; the apical part with an incipient lateral lobe and a ventral heel. Aedeagus subtriangular, unmodified. Lateral lobe relatively long (0.42). Genital pump (0.155 long), each filament 0.63 long or 4 x length of pump, tip enlarged. Cercus as shown.

*Female*: Wing length 2.45; width 0.76. Coloration as in ♂. Head height 0.43; width 0.39. Eyes separated by 0.13 or distance = to ca. 6.6

facet diameters. Flagellomere I (0.31 long) nearly  $1.3 \times$  length of II + III; ascoids longer than those of o but not reaching end of flagellomere II; on all flagellomeres except last. Length of palpal segments: 1 (0.014), 2 (0.20), 3 (0.19), 4 (0.12), 5 (0.39); palp 2 with ca. 5 apical sensilla, palp 3 with 25+ sensilla on apical half. Labrum 0.36 long. Cibarium with 4 sharp horizontal teeth evenly spaced, 2 transverse rows of subequal vertical teeth, ca. 13 teeth in each row; chitinous arch complete; pigment patch subtriangular, well defined. Pharynx 0.20 long, unarmed but with distinct ridges. Pleura with 9-10 upper and 2 lower episternal setae. Length of wing vein sections: *Alpha* (0.67), *beta* (0.20), *delta* (0.26), *gamma* (0.41). Length of femora, tibiae, and basitarsi: Foreleg, 0.88, 0.99, 0.59; midleg, 0.83, 1.18, 0.66; hindleg, 0.87, 1.34, 0.78. Abdominal sternite 3 with paired circular openings laterally. Tergite 8 with 1 or 2 setae on each side. Spermathecae sac-like, as figured; common duct ca.  $3 \times$  length of individual duct. Cerci unremarkable.

*Distribution:* Colombia (Valle).

*Material examined:* Colombia. ♂ holotype (no. 512), ca. 15 km SW of Cali (1600 m above sea level) near Rio Pance (Valle), on tree trunk, 8 Aug. 1973, D.G.Y. & S. Ayala. ♀ allotype (no. 513), ca. 10 km W of Cali (1800 m above sea level), near Pichinde (Valle), rock crevice, 2 Aug. 1973, D.G.Y. & R.C.W. Paratypes (nos. 514-526), 1 ♂, 3 ♀♀, same data as allotype except taken on 31 July 1973. 3 ♀♀, same data as allotype. 1 ♂, 5 ♀♀, same data as holotype.

*Discussion:* The sexes of *L. rozalesi* were associated on the basis of collecting data, coloration and metrical characters. No other *vernucarum* group species were taken at either of the two localities listed above.

The male of this species resembles that of *L. andina* in details of the male genitalia but the setae of the basal coxite tuft are thicker, the paramere and its setation are different, the style lacks a small sub-terminal seta, and the shorter of the two proximal spines is unmodified. The male of *L. verrucarum* (Townsend), an allopatric Peruvian species, is similar to these species, but the proximal spines of the style are not inserted on long or well marked tubercles and the parameres are different.

Without males, I am unable to separate the females of *L. moralesi* from those of most other *verrucarum* group species. Identifications based on this sex alone require confirmation.

I am pleased to name this species after Dr. Alberto Morales-Alarcon, not only for his valuable assistance in this study, but to acknowledge his significant contribution to our knowledge of Colombian phlebotomines.

30. *Lutzomyia nuneztovari*  
(Fig. 23)

*Phlebotomus nunez-tovari* Ortiz, 1954: 232 (♂ holotype, Duaca, Lara, Venezuela). Scorza & Ortiz, 1960: 434 et seq. (ecology). Pifano et al., 1962: 387 (♂ keyed). Ortiz & Scorza, 1963: 344 (Venezuela). Scorza et al., 1967: 194 (♂ keyed), 195 (♀ keyed), 196 (collecting data).

*Lutzomyia nuneztovari*: Theodor, 1965: 183 (mention), Martins & Silva, 1965: 275 (mention). Martins et al., 1965: 9 (mention). Morales et al., 1969b: 385 (mention). Forattini, 1971a: 103 (listed). Martins & Fraiha, 1971: 364 (cf. to *evangelistai*). Young, 1972a: 312 (mention). Osorno et al., 1972b: 18 (mention). Forattini, 1973: 265 (as synonym of *ovallesi*).

*Distribution*: Venezuela, Colombia (Huila).

*Material examined:* Colombia. 1 ♂, Timana (Huila), Shannon trap, 21 July 1971, C. Aguila. 1 ♂, same data but 1-2 Aug. 1971. 1 ♀, same data but light trap, 2-3 Aug. 1971. 1 ♀, same data but Shannon trap, 12-13 Aug. 1971.

*Discussion:* Unlike Forattini (1973), I consider *L. nuneztovari* and *L. ovallesi* to be distinct species, the male of the latter having a sub-terminal on the style (lacking in *nuneztovari*) and with different parameres. The female of *ovallesi* has elongate spermathecae, slightly constricted in the middle (Fig. 27J) unlike those of *nuneztovari* which are stout and non-constricted (Scorza et al., 1967, in key and Fig. 23E this paper).

Fairchild (pers. comm.) examined the holotype of *nuneztovari* in 1963, and noted the following: Tips of genital filaments slightly expanded. Subterminal seta of style lacking. Parameres long and slender, very slightly clubbed, not pointed as shown by Ortiz (1954) but blunt, slightly shorter than lateral lobes. *Alpha* of wing venation very long, at least equal to *beta* + *gamma*, not as shown by Ortiz (1954).

The males from Huila, Colombia, agree with the description of the holotype by Ortiz (1954) (as slightly emended by Fairchild) and I therefore have no doubt that they are conspecific. The Colombian females of *nuneztovari* are in poor condition with partially missing palpi and antennae, but other structures are intact and are described as follows.

*Female* (n = 2): Wing length 2.25; width 0.74. Head, mesonotum, and abdominal tergites strongly pigmented, rest of insect, including pleura, pale or dusky but the degree of pigmentation difficult to determine due to overstaining. Head height 0.42-0.43. Eyes separated by 0.11-0.12 or by distance = to ca. 6 facet diameters. Length of palpal segment 1 (0.05),

2 (0.19), others missing; 2 palpal sensilla on apical part of segment 2. Labrum 0.32 long. Cibarium with 4 sharp equidistant horizontal teeth and 12-20 small vertical teeth in a row; chitinous arch complete; pigment patch subtriangular, the posterior (wider) half more heavily pigmented. Pharynx 0.20 long, unarmed. Pleura with 12 upper and 4 lower episternal setae. Length of wing vein sections: *Alpha* (0.71), *beta* (0.22), *delta* (0.32), *gamma* (0.31). Length of femora, tibiae, and basitarsi: Foreleg, 0.78, 0.86, 0.54; midleg, 0.83, 1.05, 0.64; hindleg, 0.88, 1.27, 0.71. Abdominal sternite 2 with a median clear area not enclosed posteriorally. Tergite 8 with 5-7 setae on each side. Spermatheca wrinkled and sac-like, terminal knob deeply recessed; common sperm duct and most of individual ducts invisible. Cerci unremarkable.

31. *Lutzomyia ovallesi*  
(Fig. 27)

*Phlebotomus ovallesi* Ortiz, 1952: 155 (♂ holotype, Duaca, Lara, Venezuela, not San Felipe, Yaracuy, Venezuela). Ortiz, 1954: 239 (♂, redescr., figs.). Lewis & Garnham, 1959: 87 (♀ descr., Belize). Fairchild & Hertig, 1959: 122 (Central American records). Scorza & Ortiz, 1960: 434 (ecology). Hanson, 1961: 317 (breeding sites). Johnson & Hertig, 1961: 765 (rearing data). Pifano et al., 1962: 370 et seq. (♂, ♀ keyed, redescr., figs.). Strangways-Dixon & Lainson, 1962: 297 (with flagellates, Belize). Johnson et al., 1963: 110 (negative for flagellates). McConnell & Correa, 1964: 527 (infected with fungus). Williams et al., 1965: 65, 70 (Belize). Rosabal, 1966: 1 (Costa Rica). Biagi et al., 1966: 368 (Mexico, ♀ figs.). Thatcher & Hertig, 1966: 50 (biting man and *Potos*, Panama). Scorza et al., 1967: 191 (distrib.).

Hanson, 1968: 64 (larva, pupa, descr.). Osorno et al., 1967: 29 (Colombia).

*Sergentomyia ovallesi*: Barretto, 1955: 185 (listed). Barretto et al., 1956: 51 (cf. to *firmatoi*).

*Lutzomyia ovallesi*: Barretto, 1962: 98 (listed). Aitken et al., 1968: 264 (Trinidad, on man). Williams, 1970: 332 et seq. (summary of studies, refs., Belize). Tesh et al., 1971a: 153 (blood meals). Chaniotis et al., 1971a: 100 (listed). Osorno et al., 1972a: 28 (Colombian records). Shaw et al., 1972: 719 (mention). Chaniotis et al., 1972: 95 (collecting data). Christensen, 1972a: 88 (listed). Christensen et al., 1972: 57 (light trap catch). Rutledge & Mosser, 1972: 366 (listed). Forattini, 1973: 122 et seq. (gen. review, refs., figs.). Lewis, 1975a: 500 et seq. (mouthpart morphol.). Rutledge et al., 1975: 181 (ecology). Rutledge & Ellenwood, 1975a: 73 (ecology, refs.), 1975c: 87 (mention). Williams, 1976a: 603 (in caves, Belize); 1976b: 618 (mention).

*Brunptomysia ovallesi*: Lewis, 1965: 378 et seq. (internal morphol.).

*Distribution*: Mexico, Belize, Honduras, Nicaragua, Costa Rica, Panama, Colombia (Antioquia, Boyaca, Caldas, Choco, Cundinamarca, Magdalena, Santander), Venezuela, Trinidad.

*Material examined*: Colombia. 34 ♂♂, 19 ♀♀, Teresita (Choco), in tree buttresses, March-Nov. 1967, D.G.Y. 1 ♂, near Rio Don Diego, E of Santa Marta (Magdalena), 15 Aug. 1973, D.G.Y. & R.C.W. Panama. 2 ♀♀, Almirante (Bocas del Toro), Shannon trap, 13 July 1951, A. Quinones. Trinidad. Both sexes from various localities, to be discussed in a forthcoming paper.

*Discussion*: The female of *ovallesi*, a man biter in several countries including Colombia (Osorno et al., 1972a), is readily identified by the



elongate constricted spermathecae (Fig. 27J). Flagellates, apparently not *Leishmania*, have been recovered from wild caught specimens in Panama and Belize (Williams, 1970). Based on evidence gathered by Thatcher and Hertig (1966) and Tesh et al. (1971a), this species feeds primarily, if not exclusively, on mammals. In Panama, immatures were found in soil at the base of trees (Hanson, 1961), less commonly on the open forest floor (Rutledge and Ellenwood, 1975a).

32. *Lutzomyia quasitownsendi*  
(Fig. 28)

*Lutzomyia quasitownsendi* Osorno, Osorno, & Morales, 1972b: 10 (♂ holotype, ♀, Barbosa, Santander, Colombia). Osorno et al. 1972a: 29 (Colombian records).

*Distribution:* Colombia (Santander).

*Material examined:* 1 ♂ (paratype no. 819), Barbosa (Santander), 30 Oct. 1968. 1 ♀ (paratype no. 2702), same data but taken on 23 June 1967. Both specimens in collection at UF.

*Discussion:* This little-known species was well described and illustrated by Osorno et al. (1972b). I have nothing further to add.

33. *Lutzomyia sauroida*  
(Fig. 28)

*Lutzomyia sauroida* Osorno, Morales, & Osorno, 1972c: 433 (♂ holotype, vereda San Pedro, Municip. Santa Ana, Boyaca, Colombia; ♀, same locality except San Martin instead of San Pedro). Osorno et al., 1972a: 29 (Colombian records).

*Distribution:* Colombia (Boyaca).

*Material examined:* Colombia. 1 ♂ (paratype no. 2690), 1 ♀ (paratype no. 2685, both in collection at INPES), type locality, 29 Oct. 1968.

*Discussion:* This species and *L. townsendi* (Ortiz) (Fig. 12) from Venezuela are very similar, the males of *sauroida* having slightly stronger setae on the dorsum of the parameres but are otherwise indistinguishable. I can find no differences between the females of the two species but hesitate to treat *sauroida* as a junior synonym of *townsendi* until more material of the former species becomes available.

34. *Lutzomyia spinicrassa*  
(Fig. 28)

*Lutzomyia spinicrassa* Morales, Osorno, Osorno, & Hoyos, 1969b: 383 (♂ holotype, vereda Umbabita, Municip. Almeida, Boyaca, Colombia; ♀, vereda Chitavita, Municip. Guayata, Boyaca, Colombia). Osorno et al., 1972a: 30 (Colombian records). Forattini, 1973: 213 et seq. (o fig., keyed).

*Distribution:* Colombia (Boyaca).

*Material examined:* Colombia. 1 ♂ (paratype no. 2654), 1 ♀ (paratype no. 2652), Guateque (Boyaca), 22 Oct. 1968, A. Morales & J. Ochoa. Both specimens in collection at UF.

*Discussion:* The male of *spinicrassa* differs from other males in the *verrucarum* group by the size and shape of the terminal spine of the style (Fig. 28D). This species, known only from Boyaca Dept. at elevations ranging from 1430 to 1640 m above sea level, was found resting in tree holes and on walls inside of houses.

Figure 22

*Lutzomyia serrana* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, G. Paramere, H. Spermathecae, I. Genital pump and filaments, J. Female wing, K. Male wing, L. Female cibarium.

Male: Alto Curiche, Choco Dept., Colombia

Female: Rio Anori, Antioquia Dept., Colombia

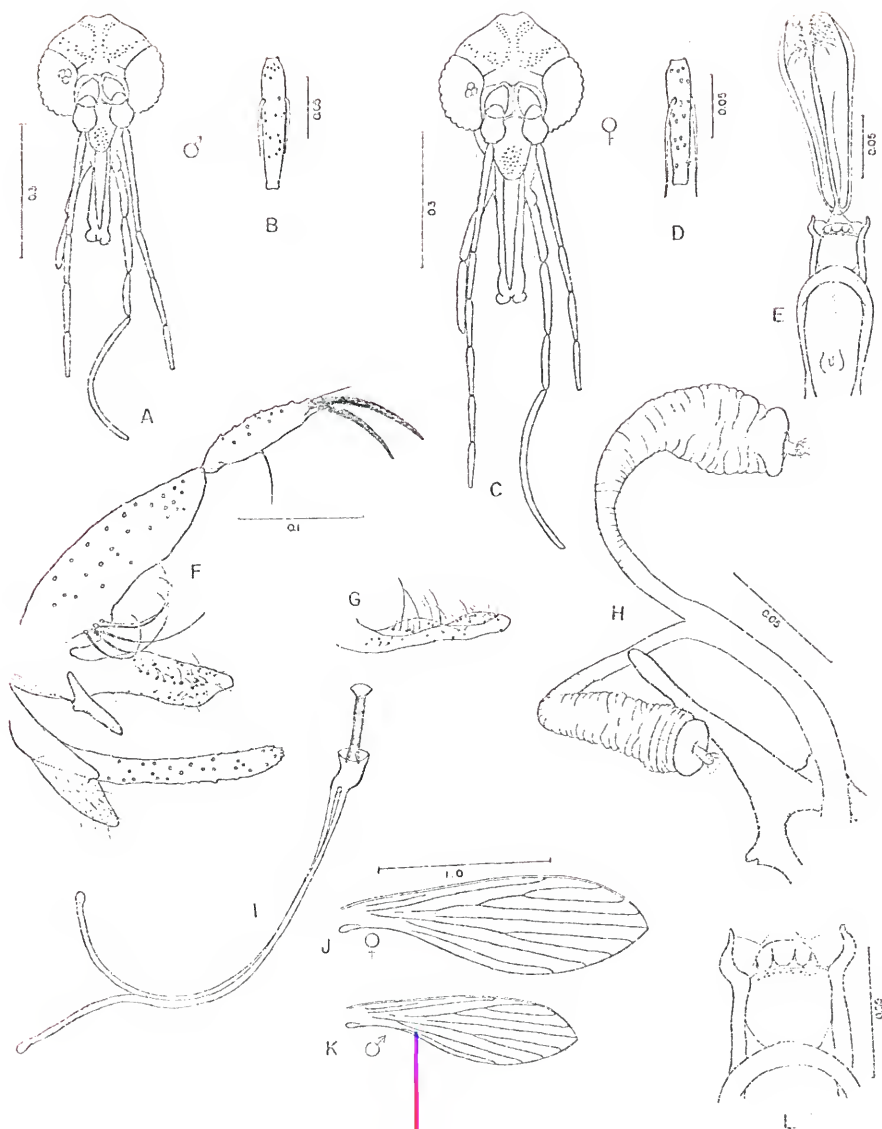


Figure 23

*Lutzomyia andina* male -- A. Male genitalia.

Male: El Charquito, Cundinamarca Dept., Colombia

*Lutzomyia disiuncta* male -- B. Male genitalia.

Male: Bogota, Municip. de Suba, Cundinamarca Dept., Colombia

*Lutzomyia nuneztovari* -- C. Female cibarium, D. Male genitalia,  
E. Spermatheca; the common duct and part of individual duct not  
visible.

Male: Timana, Huila Dept., Colombia

Female: Same locality as male

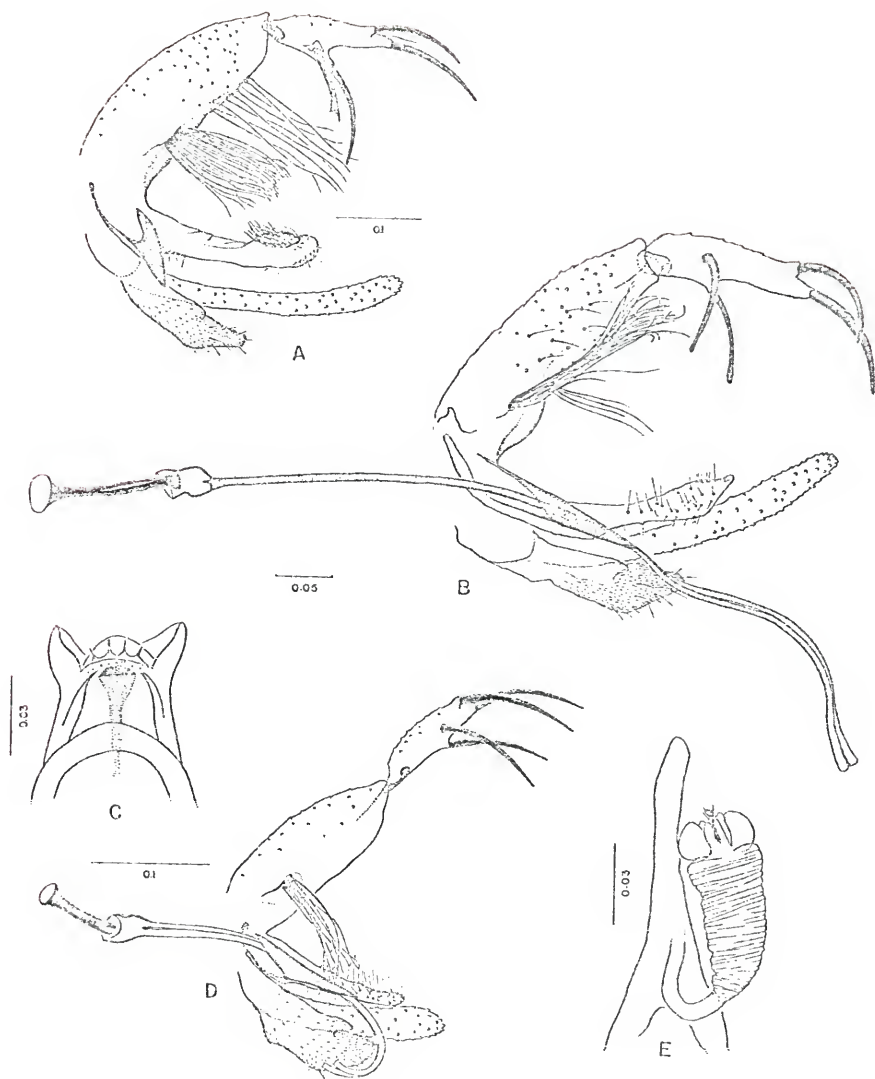


Figure 24

*Lutzomyia columbiana* -- A. Genital pump and filaments, B. Male head, C. Male flagellomere II, D. Female head, E. Female flagellomere II, F. Female cibarium and pharynx, G. Male genitalia, H. Female cibarium, I. Spermathecae, J. Body of spermatheca, K. Female wing, L. Male wing, M. Spermathecae.

Male: San Pedro, Nariño Dept., Colombia

Female: Same locality as male

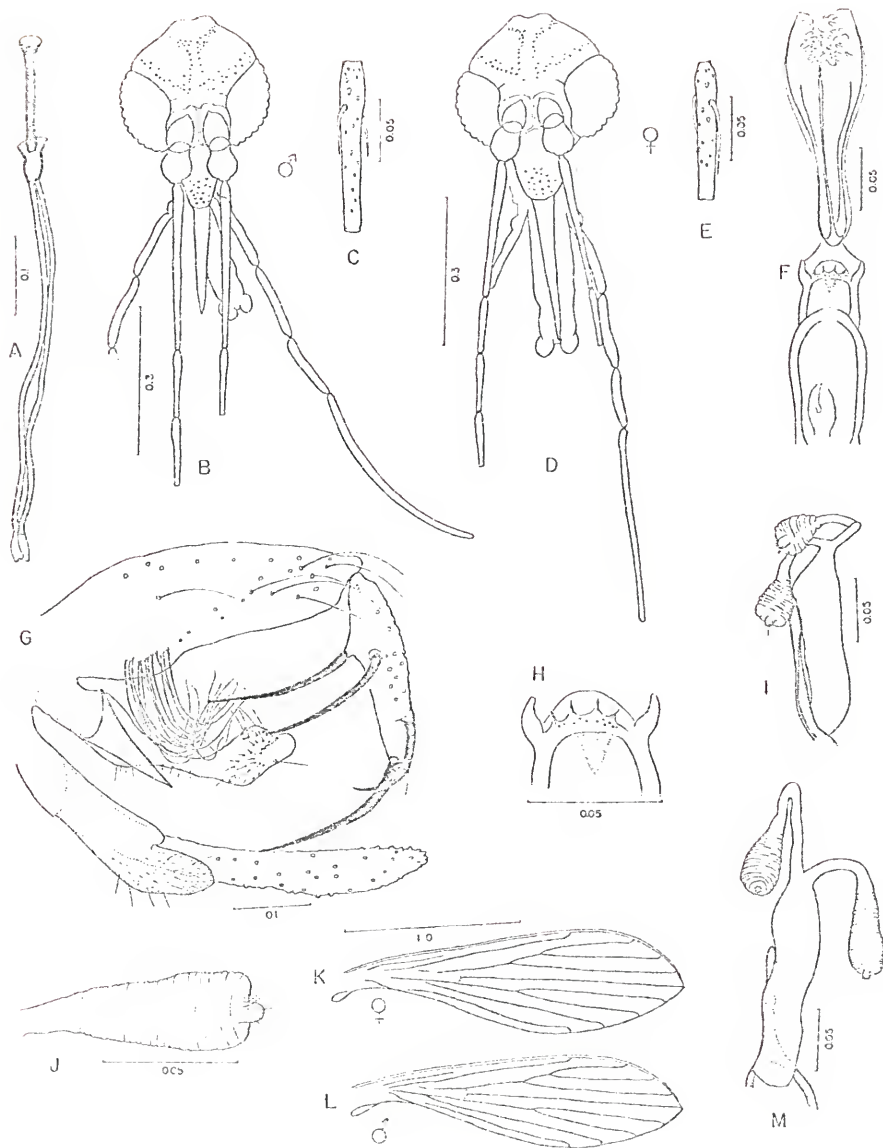




Figure 25

*Lutzomyia evansi* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Genital pump and filaments, G. Genital pump, same scale as 25H, H. Male genitalia, I. Paramere, outer aspect, J. Spermathecae, K. Body of spermatheca, L. Female wing, M. Male wing, N. Female cibarium.

Male: Guapilonar, Carazo, Nicaragua

Female: Same locality as male

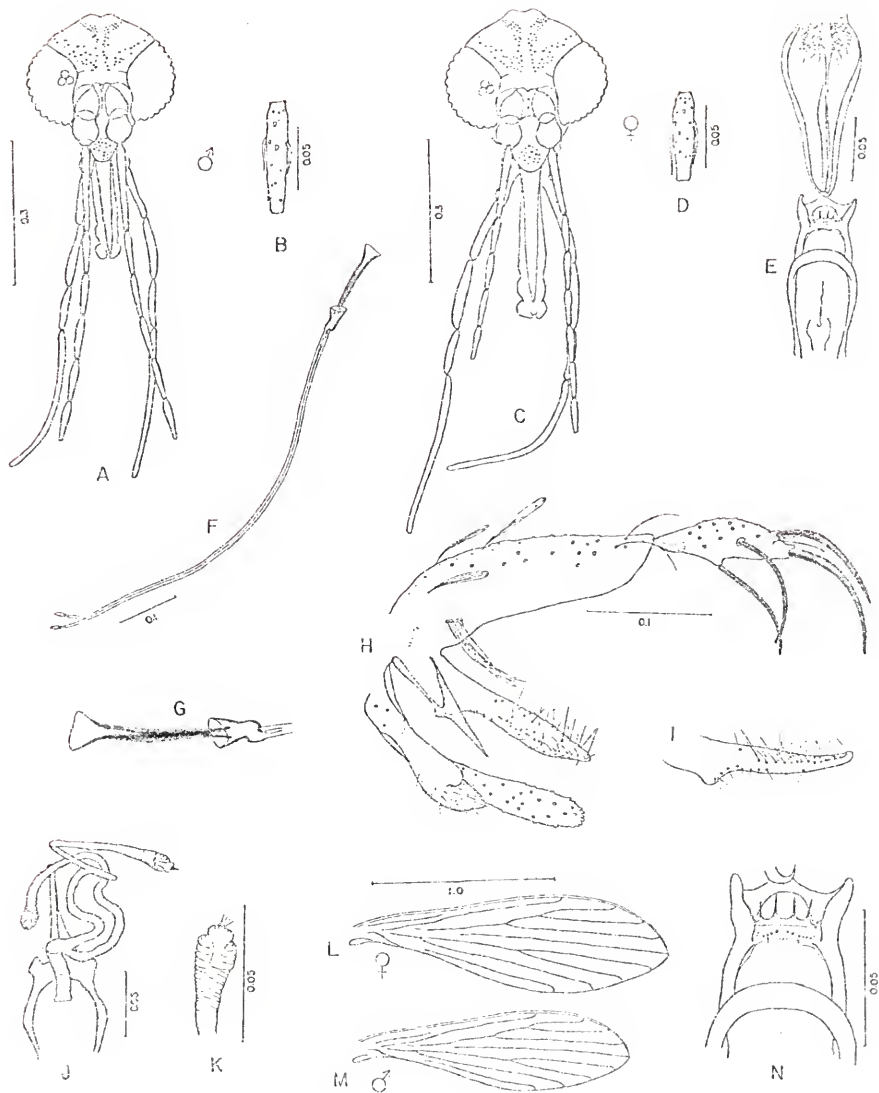


Figure 26

*Lutzomyia moralesi* -- A. Female head, B. Female wing, C. Male wing, D. Male head, E. Male flagellomere II, F. Female flagellomere II, G. Female cibarium, H. Genital pump, same scale as Fig. 26J, I. Tip of genital filament, same scale as Fig 26G, J. Male genitalia, K. Spermathecae.

Male: Near Rio Pance, Valle Dept., Colombia

Female: Near Pichinde, Valle Dept., Colombia

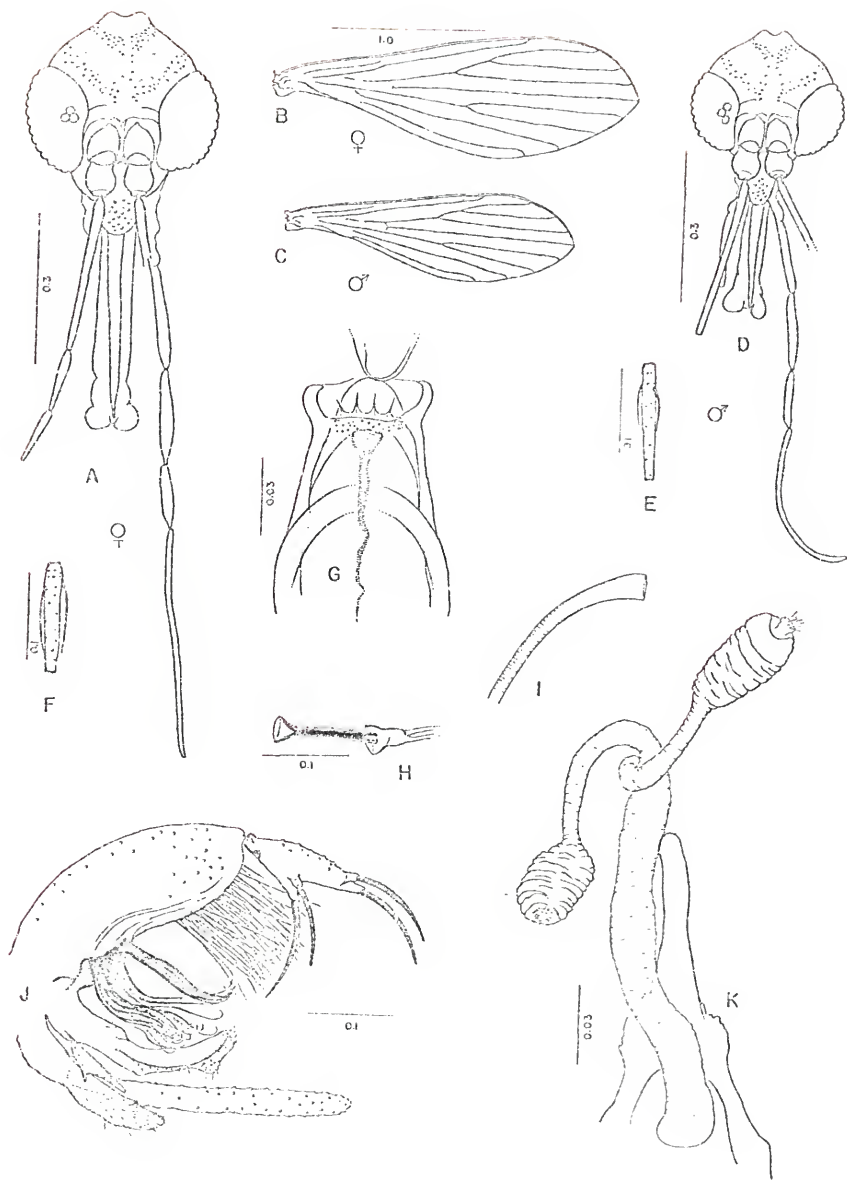


Figure 27

*Lutzomyia ovallesi* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Genital pump and filaments, same scale as Fig 27G, G. Male genitalia, H. Female wing, I. Male wing, J. Spermathecae, K. Female cibarium.

Male: Rio Sabana, Darien Prov., Panama

Female: Same locality as male

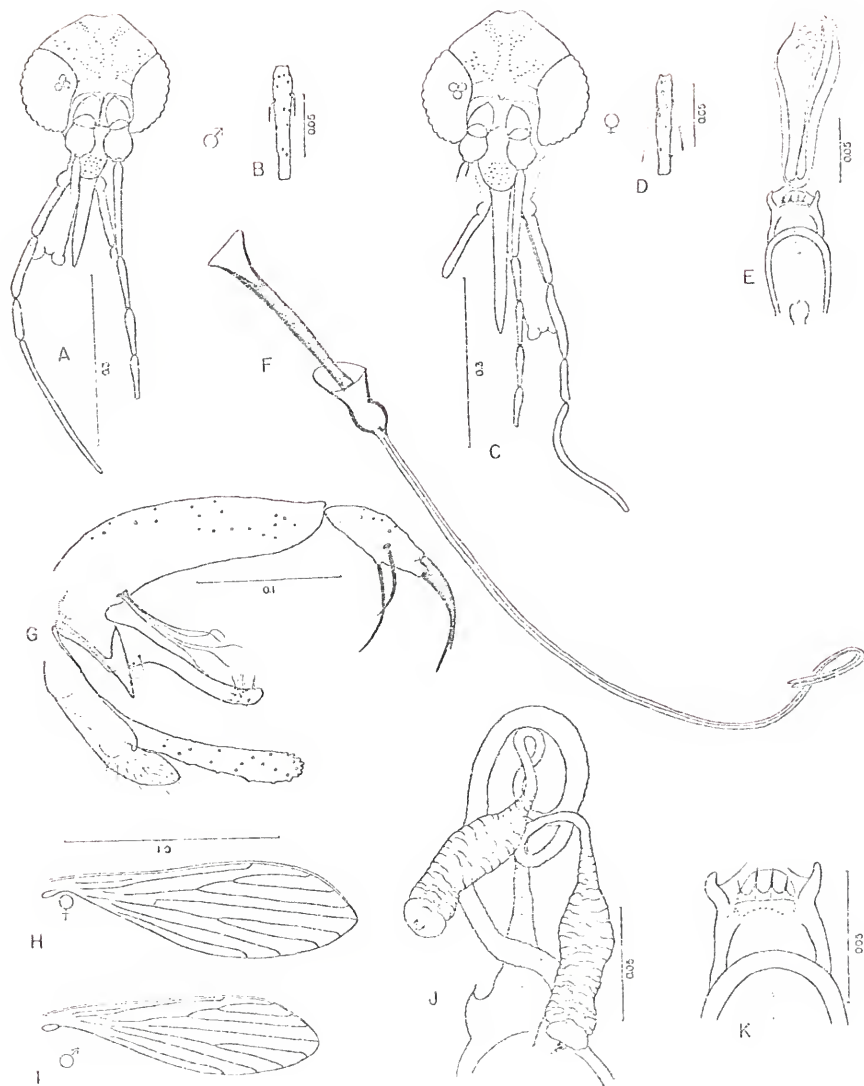


Figure 28

*Lutzomyia sauroida* -- A. Male genitalia, B. Female cibarium.

Male: Municip. de Santa Ana, Boyaca Dept., Colombia

Female: Same locality as male

*Lutzomyia quasitcunsendi* -- C. Male genitalia.

Male: Barbosa, Santander Dept., Colombia

*Lutzomyia longiflocosa* -- D. Male genitalia.

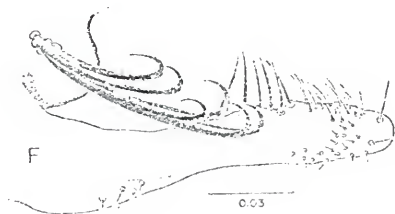
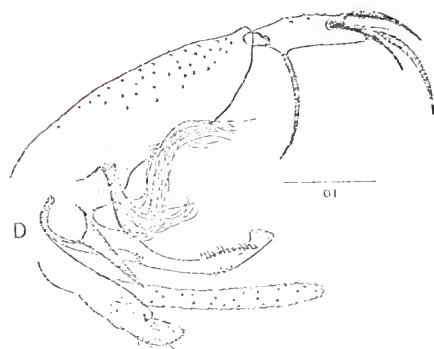
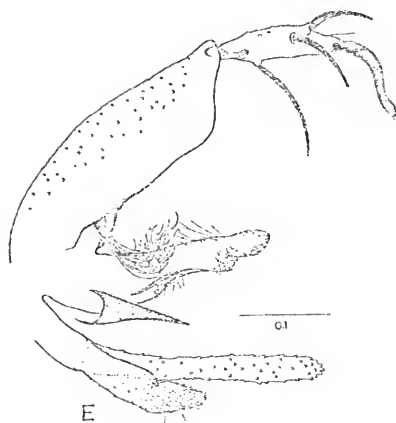
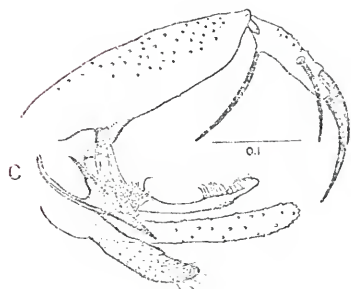
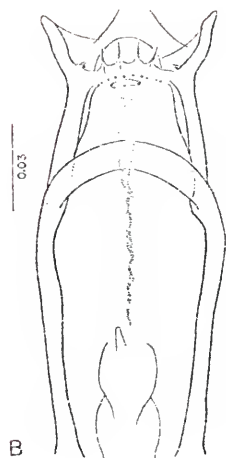
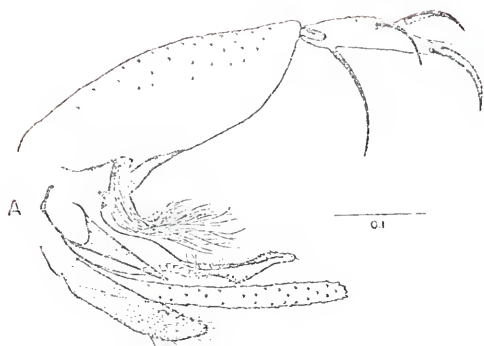
Male: Municip. de Tello, Huila Dept., Colombia

*Lutzomyia spinicrassa* -- E. Male genitalia.

Male: Guateque, Boyaca Dept., Colombia

*Lutzomyia odax* -- F. Coxite tuft and paramere.

Male: Almirante, Bocas del Toro Prov., Panama





Vespertilionis Group Theodor, 1965

With the center of distribution in Central America, the *vespertilionis* group species are divided into 2 series following Theodor (1965) -- the series *vespertilinois* (5 spp.) and the series *deleoni* (3 spp.). Barretto (1962) created the subgenus *Coromyia* to accomodate them and other species, mostly those in the *verrucarum* group. Forattini (1971a, 1973) divides the *vespertilionis* group species by placing 1 in the subgenus *Lutzomyia* França, 2 in the subgenus *Dampfomyia* Addis, while leaving the others in *Coromyia*. In my opinion, this arrangement is unnecessary when the species are classified using a combination of character states.

Two sibling species in the series *vespertilionis* are known to occur in Colombia. The females feed on bats and are morphologically indistinguishable.

Key to Species

Males

1. Paramere with dorsal setae on distal half of structure . . . . .  
. . . . . *L. vespertilionis* (Fig. 29)

- Paramere with dorsal setae restricted to distal third of structure  
. . . . . *L. isovespertilionis* (Fig. 29)

35. *Lutzomyia isovespertilionis*  
(Fig. 29)

*Phlebotomus isovespertilionis* Fairchild & Hertig, 1958a: 516 (♂ holotype, ♀, reared from eggs laid by ♀ from tributary of Rio Cocoli, Canal Zone). Johnson & Hertig, 1961: 765 et seq. (rearing data).

Thatcher & Hertig, 1966: 46 (mention). Hanson, 1968: 88-90 (larva, pupa, descr.).

*Phlebotomus vespertilionis*: Fairchild & Hertig, 1947b: 617 et seq. (in part, descr., fig.).

*Lutzomyia isovespertilionis*: Barretto, 1962: 97 (listed). Chaniotis et al., 1971a: 344 et seq. (in part, pop. dynamics, Panama). Chaniotis et al., 1972: 94 et seq. (resting sites, Panama). Christensen et al., 1972: 57 et seq. (collecting data, infected with trypanosomes, Panama). Christensen, 1972a: 88-89 (mention). Forattini, 1973: 122 et seq. (gen. review, fig.). Christensen & Herrero, 1973: 579 et seq. (collecting data, Panama). Rutledge & Mosser, 1975: 411 (mention). Herrero & Christensen, 1969: 62 (collecting data, Panama).

*Distribution*: Panama, Colombia (Choco).

*Material examined*: Colombia. 1 ♂, Curiche (Choco), tree buttress, 5 July 1967, D.G.Y. 4 ♂♂, Teresita (Choco), tree buttress, 18 May 1967, D.G.Y. Panama. 1 ♂, Cruces trail, Madden Forest, Canal Zone, hollow tree, 7 Sept. 1949, M. Hertig. 3 ♂♂, Cerro Campana (Panama Prov.), tree hollows and buttresses, 2 Oct. 1949, M. Hertig & H. Trapido.

*Discussion*: See *L. vespertilionis*

36. *Lutzomyia vespertilionis*  
(Fig. 29)

*Phlebotomus vespertilionis* Fairchild & Hertig, 1947b: 617 (♂ holotype, Cerro Campana, Panama Prov., Panama). Hertig & Fairchild, 1950: 91 (abdominal sternites). Barretto, 1951: 225 (distrib.). Vargas & Diaz-Nájera, 1951b: 101 (cf. to *beitrani*). Floch & Abonnenc, 1952: 30-48 (♂, ♀, keyed). Rosabal, 1954: 10, 28-29 (measurements, figs.,

Costa Rica, sp. no. 12 = *vespertilionis*). Rodriguez, 1956: 76 et seq. (Ecuador). Fairchild & Hertig, 1958a: 510 (keyed), 514 ( $\sigma^A$ ,  $\phi$ , redescr., figs.). Fairchild & Hertig, 1959: 122 (Central American records). Hanson, 1961: 320 (breeding site, Panama). Johnson & Hertig, 1961: 765 et seq. (rearing). McConnell & Correa, 1964: 523 et seq. (infected with trypanosomes & fungi, Panama). Thatcher & Hertig, 1966: 46 et seq. (mention). Hanson, 1968: 88-90 (larva, pupa, descr., figs.).

*Lutzomyia vespertilionis*: Barretto, 1962: 97 (listed). Theodor, 1965: 184 ( $\sigma^A$ ,  $\phi$ , figs.). Barreto, 1969: 468 (Valle, Colombia). Zeledon & Rosabal, 1969: 221-227 (as vector of bat trypanosome). Tesh et al., 1971a: 152-153 (in part, blood meals). Chaniotis et al., 1971a: 344 et seq. (in part, pop. dynamics, Panama). Christensen et al., 1971: 116 et seq. (pyloric armature, figs.). Tesh et al., 1972: 90 et seq. (in part, blood meals). Chaniotis et al., 1972: 94 et seq. (resting sites, Panama). Christensen, 1972a: 88-89 (mention). Christensen, 1972b: 683 et seq. (rearing). Osorno et al., 1972a: 32-33 (Colombian records). Rutledge & Mosser, 1972: 307 (mention). Christensen & Herrero, 1973: 579 et seq. (collecting data, infected with trypanosomes, Panama). Forattini, 1973: 123 et seq. (gen. review, figs.). Rutledge & Mosser, 1975: 411 (mention).

*Distribution*: Costa Rica, Panama, Colombia (Antioquia, Bolivar, Boyaca, Choco, Valle), Ecuador.

*Material examined*: Colombia. 3  $\sigma^A$ , Rio Anori (Antioquia), tree trunks, 6 Feb. 1970, C.H.P. 2  $\sigma^A$ , 1  $\phi$ , same data but Sept. 1970, D.G.Y. 4  $\sigma^A$ , 2  $\phi\phi$ , Anchicaya Dam (Valle), tree trunks, 9 Aug. 1974, D.G.Y. & R.C.W. 7  $\sigma^A$ , 14  $\phi\phi$ , same data but light trap at entrance of tunnel,

10-11 Aug. 1974. 1 ♂, 1 ♀, 25 km E of Buenaventura (Valle), tree trunks,  
11 Aug. 1974, D.G.Y. & R.C.W. Ecuador. 15 ♂♂, 1 ♀, 17 km E of Santo  
Domingo de los Colorados (Pichincha), tree trunks, 4-6 May 1976, D.G.Y.  
& T. Rogers. Panama. 1 ♂ (holotype no. 761), Cerro Campana (Panama),  
shallow cave, 17 Jan. 1947.

*Discussion:* In structure and habits, *L. vespertilionis* and *L. isovespertilionis* are remarkably similar, both species often being found in tree hollows associated with bats. At least one species of *Trypanosoma* is transmitted to these mammals by one or both of these flies (Zeledon and Rosabal, 1969).

The preferred breeding site(s) of *vespertilionis* and *isovespertilionis* has not been determined (Rutledge and Mosser, 1972), the only wild caught larvae being reported by Hanson (1961, 1968) who recovered this stage on two occasions in soil and bat guano inside of hollow trees. Apparently the larvae and pupae of these species are indistinguishable (Hanson, 1968).

*Lutzomyia vespertilionis* ranges as far south as Guayas Province, Ecuador. *Lutzomyia isovespertilionis* probably has a more limited distribution as noted by Fairchild and Hertig (1958a), its southernmost locality at present being Choco Department, Colombia. These are the only *vespertilionis* group species which occur in South America. Fairchild and Hertig (1958a) provide further information on collecting data, distribution, and taxonomy.

Figure 29

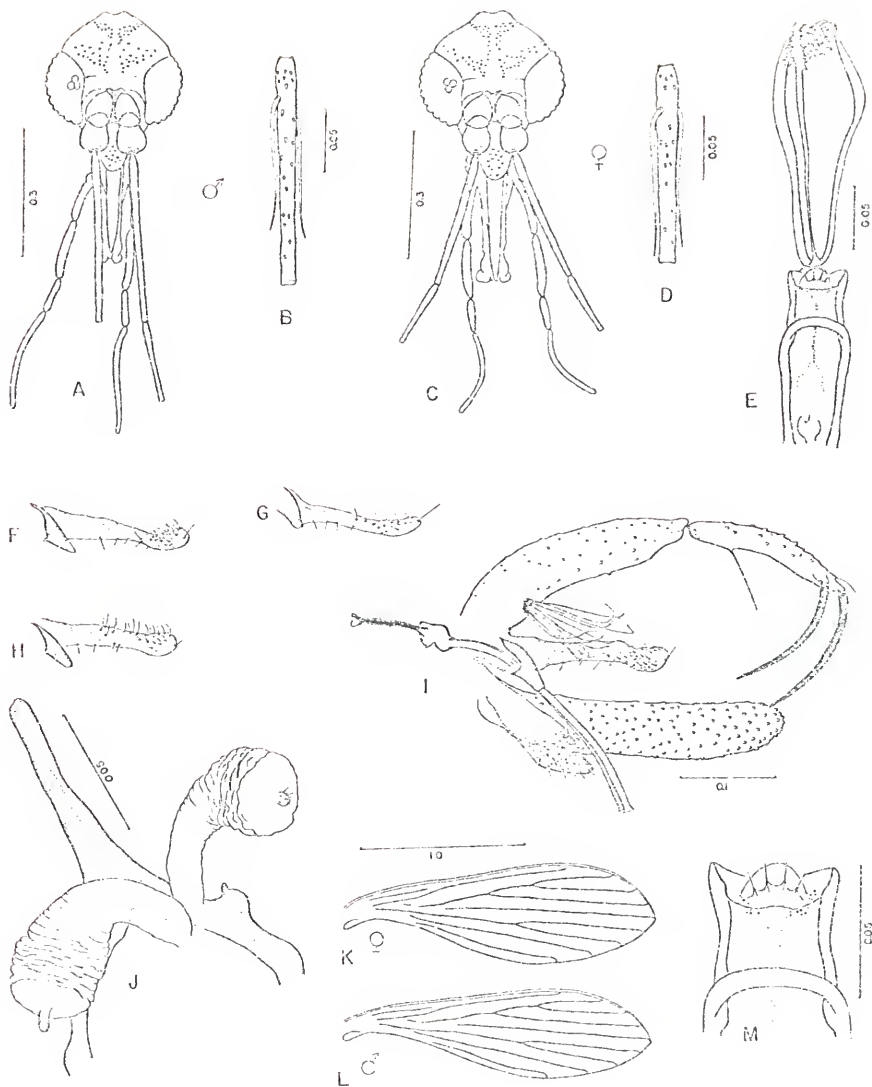
*Lutzomyia vespertilonis* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, G. Paramere, H. Paramere of male from Panama, I. Male genitalia, J. Spermathecae, K. Female wing, L. Male wing, M. Female cibarium.

Male: Rio Anori, Antioquia Dept., Colombia (except Fig. 29H)

Female: Same locality as male

*Lutzomyia isovespertilionis* -- F. Paramere.

Male: Panama Canal Zone



Subgenus *Dampfomyia* Addis, 1945

The 5 species in this subgenus are characterized by several features (Fairchild and Hertig, 1956; Theodor, 1965), some of which are shared by *L. aquilonia* (Fairchild and Harwood) of the *vespertilionis* group and members of the *delpozoi* group Lewis et al. (1978). The spermathecae of the *Dampfomyia* species are large with bubble-like expansions and could have been derived from the *deleoni*-type spermathecae of the *vespertilionis* group. Like species in these two groups, the *Dampfomyia* spp. do not ordinarily bite man and there are more species in Mexico and Central America than elsewhere.

The preferred host(s) of *L. rosabali*, the only *Dampfomyia* sp. in Colombia or South America, is unknown. Related species such as *L. anthophora* (Addis) and *L. permira* (Fairchild and Hertig) feed on small mammals, the former species probably transmitting Rio Grande virus to *Neotoma* woodrats in Texas (Calisher et al., 1977).

37. *Lutzomyia* (D.) *rosabali*  
(Fig. 30)

*Phlebotomus rosabali* Fairchild & Hertig, 1956: 310 (♂ holotype, Puerto Armuelles, Chiriqui Prov., Panama; ♀, Guarare, Los Santos Prov., Panama). Rosabal, 1954: 10 et seq. (as sp. no. 9, Costa Rica). Fairchild & Hertig, 1959: 122 (Central American records). Rosabal & Trejos, 1964: 168 (cf. to *dodgei*).

*Lutzomyia rosabali*: Barretto, 1962: 95 (listed). Theodor, 1965: 193 (listed, spermatheca fig.). Forattini, 1971a: 100 (listed). Osorno et al., 1972a: 61 (Narino, Colombia). Christensen, 1972a: 88 (listed). Forattini, 1973: 208 (spermatheca fig.), 329 (as synonym of *dodgei*).

*Distribution:* Costa Rica, Panama, Colombia (Cauca, Narino).

*Material examined:* Colombia. 6 ♂♂, 8 ♀♀, Capuli (Narino), rock crevices, March 1945, M. Hertig. 3 ♀♀, Bolivar (Cauca), Jan.-Feb. 1944, J. Burbano. Panama. 1 ♂ (holotype no. 3209), type locality, tree buttress, 9 June 1951, M. Hertig. 1 ♀ (allotype), Guarare (Los Santos), light trap, 23 Oct 1952, F. Blanton.

*Discussion:* Forattini (1973) treats *L. rosabali* as a junior synonym of *L. dodgei* (Vargas and Najera), believing, perhaps correctly, that the differences between the males are due to intraspecific geographic variation. Without a larger sample of specimens from various localities, however, I prefer to consider them a distinct based on the discussion and figures of Fairchild and Hertig (1956).

The Colombian males (Fig. 30) agree more closely with *L. rosabali* than with *L. dodgei* in the shape and setation of the dorsal arm of the paramere but the basal spine of the style is longer and more slender. The small bristle near the basal spine is absent on one style of the *rosabali* holotype and from the styles of the Colombian males.

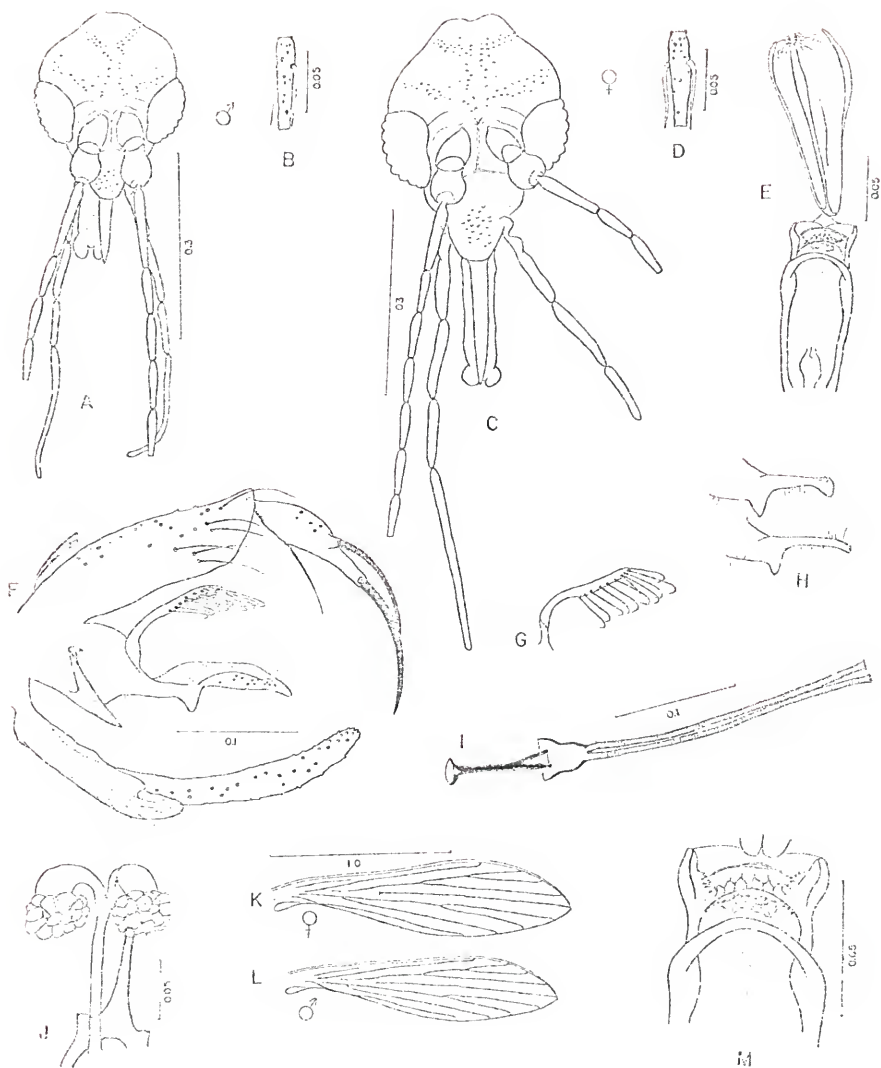


Figure 30

*Lutzomyia (D.) rosabali* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, Panamanian specimen, F. Male genitalia, G. Dorsal arm of paramere, H. Different views of paramere, I. Genital pump and filaments, J. Spermathecae, K. Female wing, L. Male wing, M. Female cibarium, Panamanian specimen.

Male: Capuli, Nariño Dept., Colombia

Female: Same locality as male (except Fig. 30E and 30M)



Subgenus *Pintomyia* Costa Lima, 1932

The 5 described species in this subgenus are characterized by a row of short spines on the hind femur. Forattini (1971a, 1973) treats *Pintomyia* as a genus, placing, I believe, undue importance on these spines which, although not exactly the same, are shared by 2 species of *Sergentomyia* França and 1 of *Brumptomyia*.

The *Pintomyia* females, like those of *Pressatia*, have well sclerotized individual sperm ducts but differ from them in other aspects (Theodor, 1965).

At present, only *L. spinosa* is known to occur in Colombia. *Lutzomyia damascenoi* (Mang.), a close ally, was reported in Meta Department by Morales et al. (1969a) but was excluded in a later work on the Colombian fauna (Osorno et al., 1972a) probably because of the uncertain identity of the specimens (2 ♂♂).

Except for *L. pessoai* (Coutinho and Barretto) and *L. fischeri* (Pinto), the *Pintomyia* spp. have not been reported feeding on man. *Lutzomyia gibsoni* (Pifano and Ortiz), recently described from Venezuela from a single female, definitely belongs in the subgenus but its identify remains uncertain based upon the original description.

38. *Lutzomyia* (Pi.) *spinosa*  
(Fig. 31)

*Phlebotomus spinosus* Floch & Abonnenc, 1942b: 1 (♂ holotype, Gallion, near Cayenne, French Guiana). Barretto, 1947: 224 (full refs.). Hertig & Fairchild, 1950: 92, 93 (abdominal sternites 1 & 2, figs., Panama). Barretto, 1951: 224 (distrib.). Floch & Abonnenc, 1952: 20 et seq. (♂, ♀, keyed, redescr., figs.).

Blancas, 1959-1960: 129-130 (cf. to *gorbitzi*). Johnson & Hertig, 1961: 765 et seq. (rearing data). Hanson, 1968: 80 (larva, pupa, descr., figs.). Morales et al., 1969a: 381 (Meta, Colombia). Pifano & Ortiz, 1972: 31 (cf. to *gibsoni*). Pifano et al., 1973: 153-154 (cf. to *gibsoni*).

*Lutzomyia spinosa*: Barretto, 1962: 93 (listed). Martins et al., 1962a: 381 (Goias, Brazil). Martins et al., 1963: 335 (Brazilian records). Christensen & Fairchild, 1971: 302 (Darien Prov., Panama). Christensen, 1972a: 88 (listed). Osorno et al., 1972a: 60-61 (Colombian records). Ward et al., 1973: 178-181 (collecting data, Para, Brazil). Christensen & Herrer, 1973: 579 (Collecting data, Panama). Lewis, 1975a: 503 et seq. (mouthpart morphol.).

*Pintomyia spinosa*: Forattini, 1971a: 104 (listed). Forattini, 1973: 123 et seq. (gen. review, figs.).

*Distribution*: Panama, Colombia (Amazonas, Antioquia, Boyaca, Caqueta, Choco, Meta), French Guiana, Brazil.

*Material examined*: Colombia. 70 ♂♂, 12 ♀♀, 17 km W of Leticia (Amazonas), tree trunks, 24-26 July 1973, D.G.Y. & R.C.W. 1 ♂, Rio Anori (Antioquia), light trap, 14 May 1970, C.H.P. 38 ♂♂, 20 ♀♀, same data but tree trunks, Sept. 1970, D.G.Y. 1 ♀, Curiche (Choco), Malaise trap, 7 July 1967, D.C.Y. Brazil. 11 ♂♂, 1 ♀, Labrea (Amazonas), tree trunks, 9 Oct. 1972, D.G.Y. 2 ♂♂, near Altamira (Para), tree trunks, 1 Oct. 1972, D.G.Y. 1 ♀, Itiatuba (Para), tree trunk, 4 Oct. 1972, D.G.Y. Panama. 2 ♂♂, 1 ♀, Cerro Campana (Panama), tree buttresses.

*Discussion*: The male parameres of *spinosa* are rather slender and the dorsal setae are distributed over the distal half of the structure. The coxite tuft consists of 6-8 setae. In *L. damasceni* the parameres

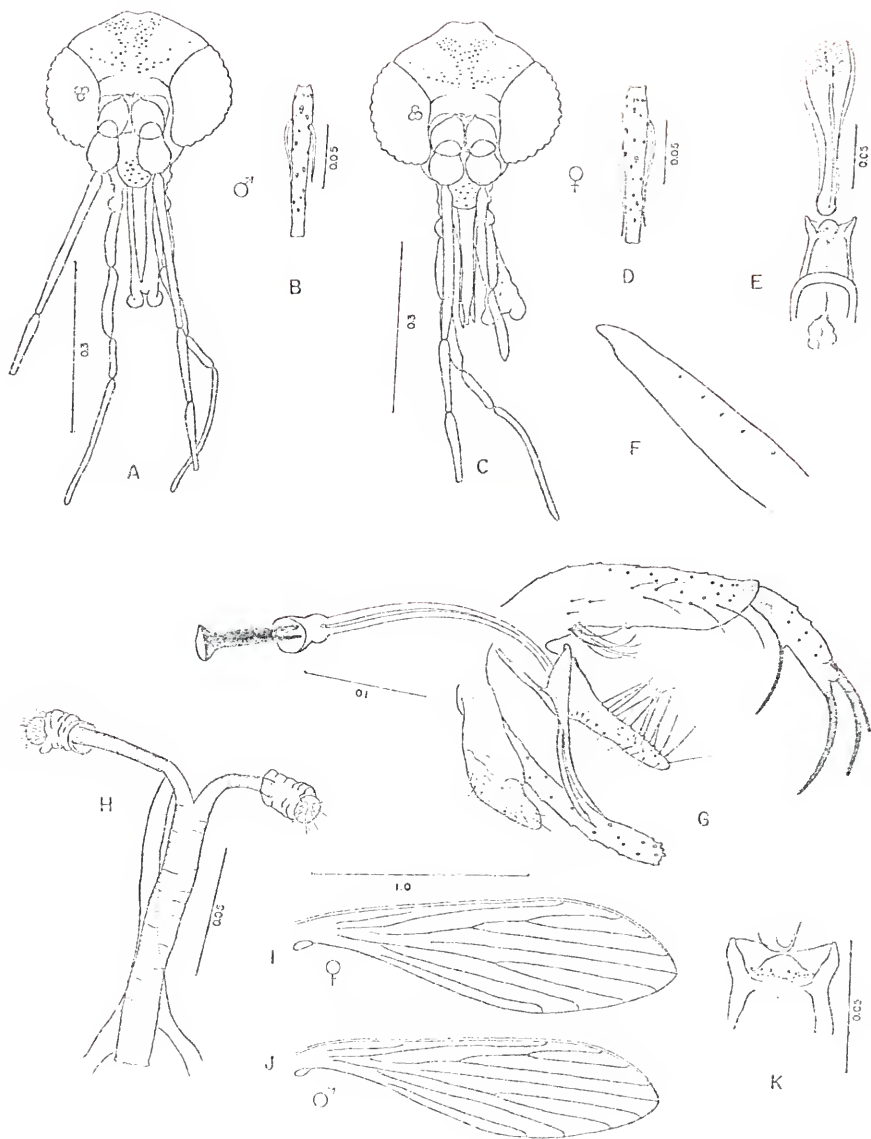
are broader, slightly clubbed apically, and the dorsal setae are less numerous, being restricted to the distal third of the structure. The coxite tuft consists of 12+ setae. The females of the two species are very similar, but differ in the relative lengths of the sperm ducts and in the distribution of their sclerotization. The common sperm duct of *spinosa* is longer than 2x the length of the individual ducts and the basal one-fourth of the latter is nonsclerotized, unlike *damascenoi* in which the individual ducts are almost completely sclerotized and the common duct is shorter, less than 2x the length of the individual ducts. The female cibarium of *L. gibsoni* has well defined, long horizontal teeth as shown by Pifano and Ortiz (1972). Those of *spinosa* and *damascenoi* are short and irregularly spaced. Adults of *L. spinosa* are commonly collected on tree trunks. Near Leticia (24-26 July 1973), this species was by far the most abundant sand fly taken in such resting sites.

Figure 31

*Lutzomyia spinosa* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Female hind femur showing spines, G. Male genitalia, H. Spermathecae, I. Female wing, J. Male wing, K. Female cibarium.

Male: Panama Canal Zone

Female: Same locality as male



Subgenus *Pressatia* Mangabeira, 1942

This small distinctive group is represented in Colombia by 3 of the 6 known species. Forattini (1971a, 1973) elevates the category to the genus level and adds several other species, which, in my opinion, belong in other groups (Young and Arias, 1977; Lewis et al., 1978). Except for *L. camposi* on rare occasions, the *Pressatia* species do not feed on human blood.

There are but slight differences among the 5 described females. *Lutzuomyia triacantha*, known from a single female in Colombia, may or may not be that species and confirmation of its presence there must await the discovery of the male.

Keys to Species

Males

1. Paramere as shown, with ca. 10 dorsally directed, blade-like setae at base. . . . . *camposi* (Fig. 32)  
  
Paramere otherwise, without blade-like setae . . . . . 2
2. Coxite with patch of fine hairs above basal tuft. Paramere broader, its width at level of ventral acute process greater than width of lateral lobe . . . . . *triacantha* (Fig. 34)  
  
Coxite without fine hairs above basal tuft. Paramere more slender, its width at level of ventral acute process less than or = to width of lateral lobe. . . . . *dysponeta* (Fig. 33)



Females

1. Individual sperm duct as long as or longer than common duct; basal 1/2 thin walled, not well sclerotized. . . . . *camposi* (Fig. 32)

Individual sperm duct much shorter than common duct, thick walled, well sclerotized throughout most of its length . . . *dysponeta* (Fig. 33)  
*triacantha*

39. *Lutzomyia* (Pr.) *camposi*  
(Fig. 32)

*Phlebotomus camposi* Rodriguez, 1952 (1950): 7 (♂ holotype, Quevedo, Los Rios Prov., Ecuador). Fairchild & Hertig, 1958b: 205 (refs.). Fairchild & Hertig, 1959: 121 (Central American records). Arzube, 1960: 157 (Ecuadorian records). Hanson, 1961: 320 et seq. (breeding sites, Panama). Johnson & Hertig, 1961: 765, 773 (rearing data). Sherlock, 1962: 322 (Santander, Colombia). McConnell & Correa, 1964: 526 (infected with gregarines & fungi). Hanson, 1968: 52 (larva, descr., figs.).

*Phlebotomus acanthobasis* Fairchild & Hertig, 1952: 508 (♂, ♀, Panama, figs.). Fairchild & Hertig, 1958b: 205 (as synonym of *camposi*).

*Lutzomyia camposi*: Barretto, 1962: 95 (listed). Barreto, 1969: 463 (Valle, Colombia). Chaniotis et al., 1971a: 345 et seq. (pop. dynamics, Panama). Osorno et al., 1972a: 59 (Colombian records). Chaniotis et al., 1972: 95 (resting sites). Christensen, 1972a: 88 (listed). Christensen et al., 1972: 57 et seq. (collecting data, Panama). Christensen & Herrer, 1973: 579 et seq. (collecting data). Rutledge & Mosser, 1975: 410 (biting man, Panama). Lewis, 1975a: 502 et seq. (mouthpart morphol.). Herrer & Christensen, 1976a: 62 (collecting data).

*Pressatia camposi*: Forattini, 1971a: 106 (listed). Forattini, 1973: 123 et seq. (gen. review, figs.). Gomes, 1975: 8 (listed).

*Distribution*: Costa Rica, Panama, Colombia (Antioquia, Boyaca, Caldas, Choco, Santander, Valle), Ecuador.

*Material examined*: Colombia. 26 ♂♂, 9 ♀♀, Rio Anori (Antioquia), light traps, May 1970, C.H.P. 9 ♂♂, 16 ♀♀, same locality, light traps & on tree trunks, Sept. 1970, D.G.Y. 50 ♂♂, 65 ♀♀, Curiche (Choco), light, Shannon, & Malaise traps, April-Dec. 1967, D.G.Y. 1 ♀, same locality, biting man, 23 May 1967, D.G.Y. 1 ♀, same data but 3 Oct. 1967. 2 ♀♀, same data but on tree trunk, 30 Oct. 1967. 4 ♂♂, 4 ♀♀, Alto Curiche (Choco), light & Malaise traps, Aug. & Nov. 1967, D.G.Y. 3 ♂♂, 6 ♀♀, Teresita (Choco), light, Shannon, Malaise traps & tree trunks, July-Nov. 1967, D.G.Y. 1 ♀, Rio Atrato (Choco), light trap, 1 Aug. 1967, D.G.Y. Ecuador. 1 ♂, 15 km E of Santa Domingo de Los Colorados (Pichincha), light trap, 5 May 1976, D.G.Y., T. Rogers, & G. Fairchild.

*Discussion*: At Curiche on two separate occasions, we collected two *camposi* females on human bait. Rutledge and Mosser (1975) also observed a female biting man in Panama but the species cannot be regarded as an important or common man biter. Aside from this and a record of specimens feeding on horses (Christensen and Herrero, 1973), the preferred hosts of *L. camposi* remain unknown.

Adults rest in burrows, less commonly on tree trunks. In Panama, one larva was recovered from soil within a burrow (Hanson, 1961).

40. *Lutzomyia* (Pr.) *dysponeta*  
(Fig. 33)

*Phlebotomus dysponetus* Fairchild & Hertig, 1952: 505 (♂ holotype, ♀ Juan Mina, Canal Zone). Rodriguez, 1953a: 25 (in copula, Ecuador,

figs.). Rodriguez, 1956: 79 (Ecuadorian records). Fairchild & Hertig, 1959: 122 (Central American records). Arzube, 1960: 157 (Ecuadorian records). Hanson, 1961: 320 et seq. (breeding sites). Johnson & Hertig, 1961: 765 (mention). Leon, 1969: 31-33 (♂, redescr., figs., Venezuela).

*Phlebotomus triacanthus*: Rodriguez, 1950: 6 (not *triacanthus* Mangabeira, 1942).

*Lutzomyia dysponeta*: Barretto, 1962: 95 (listed). Thatcher, 1968b: 1142 (arboreal breeding sites). Chaniotis et al., 1971a: 344 et seq. (pop. dynamics, Panama). Christensen & Fairchild, 1971: 302 (Darien Prov., Panama). Chaniotis et al., 1972 (resting sites). Christensen, 1972a: 88 (listed). Christensen et al., 1972: 57 et seq. (collecting data). Martins & Morales, 1972: 365 (listed). Christensen & Herrer, 1973: 579 et seq. (collecting data). Lewis, 1975a: 502 et seq. (mouthpart morphol.). Rutledge et al., 1975: 180, 182 (ecology). Rutledge & Mosser, 1975: 411 (in horse-baited trap). Rutledge & Ellenwood, 1975a: 73 (breeding site, open forest floor).

*Pressatia dysponeta*: Forattini, 1971a: 106 (listed). Forattini, 1973: 140 et seq. (gen. review, figs.). Gomes, 1975: 8 (listed).

*Distribution*: Costa Rica, Panama, Colombia (Boyaca, Choco), Venezuela.

*Material examined*: Colombia. 2 ♀♀, Puerto Boyaca (Boyaca), light trap, 25 March 1973, C.J.M. 1 ♂, same data but 1 April 1973. 2 ♂♂, 2 ♀♀, same data but 6 May 1973. 4 ♀♀, Curiche (Choco), light traps, June-July 1967, D.G.Y. 1 ♀, same locality, Shannon trap, 20 Aug. 1967, D.G.Y. 6 ♂♂, 17 ♀♀, Teresita (Choco), light, Malaise, Shannon traps, tree trunks, March-Dec. 1967, D.G.Y. Panama. ♂ holotype (no. 2012), type locality, 13 Dec. 1949, light trap, M. Hertig. ♀ allotype (no. 2012), type locality, 15 Dec. 1949, M. Hertig.

*Discussion:* In Panama, Thatcher (1968b) recovered *dysponeta* larvae from dead leaves and detritus 6+ meters above the ground in trees. Rutledge and Ellenwood (1975a), using soil emergence traps, collected 1 adult which had developed on the open forest floor. The immature stages have not been described.

Observations on hosts include pigs (Fairchild and Hertig, 1952), rodents (Christensen and Hertig, 1973), and horses (Rutledge and Mosser, 1975).

41. *Lutzomyia* (Pr.) *triacantha*  
(Fig. 34)

*Phlebotomus triacanthus* Mangabeira, 1942a: 119 (♂ holotype, Aura, Belem, Para, Brazil). Mangabeira, 1942c: 241 et seq. (♀, immatures, descr., figs.). Barretto, 1947: 226 (refs.). Damasceno et al., 1949: 832-833 (Brazilian records). Fairchild & Trapido, 1950: 410 (cf. to *christopheii*). Barretto, 1951: 224 (Brazilian records). Vargas & Diaz-Nájera, 1959: 147 (mention). Fairchild & Hertig, 1952: 508, 511 (cf. to *dysponetus* & *acanthobasis*). Floch and Abonnenc, 1952: 14, 15, 48 (mention, keyed). Pifano et al., 1962: 384 (o keyed).

*Lutzomyia triacantha* Barretto, 1962: 95 (listed). Theodor, 1965: 192 (♂, ♀, figs.). Martins et al., 1965: 4 (Rondonia, Brazil). Martins & Morales, 1972: 367 (listed). Osorno et al., 1972a: 60 (Meta, Colombia). Lewis, 1975a: 502 et seq. (mouthpart morphol.). Llanos et al., 1976: 485 (cf. to *calcarata*). Martins et al., 1976a: 488 (Peru).

*Pressatia triacantha*: Forattini, 1971a: 107 (listed). Forattini, 1973: 123 et seq. (gen. review, figs.). Gomes, 1975: 8 (listed).

*Distribution:* Colombia (Meta), Ecuador, Peru, Brazil, ?Venezuela.

*Material examined:* Colombia. 1 ♀ (INPES no. 8605), Puerto Lleras, Mapiripan (Meta), 13 May 1973, A. Morales & Vidales. Brazil. 2 ♂♂, 0. Mangabeira, no other data. Ecuador. 1 ♂, 6 ♀♀, Rio Napo at Limoncocha (Napo) 21-24 May 1976, light and flight traps, D.G.Y. & T. Rogers.

*Discussion:* The record of *L. triacantha* from Venezuela is based on Pifano et al. (1962) who included the male in a key to the phlebotomines of that country. No additional data were given.

Without males, I am unable to separate the females of *triacantha* from those of *dysponeta*, although the species probably do not occur together in Colombia or elsewhere.

Figure 32

*Lutzomyia (Pr.) camposi* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, G. Genital pump and filaments, H. Spermathecae, slightly collapsed, normal shape similar to those of Fig. 33H, I. Female wing, J. Male wing, K. Female cibarium.

Male: Curiche, Choco Dept., Colombia

Female: Same locality as male

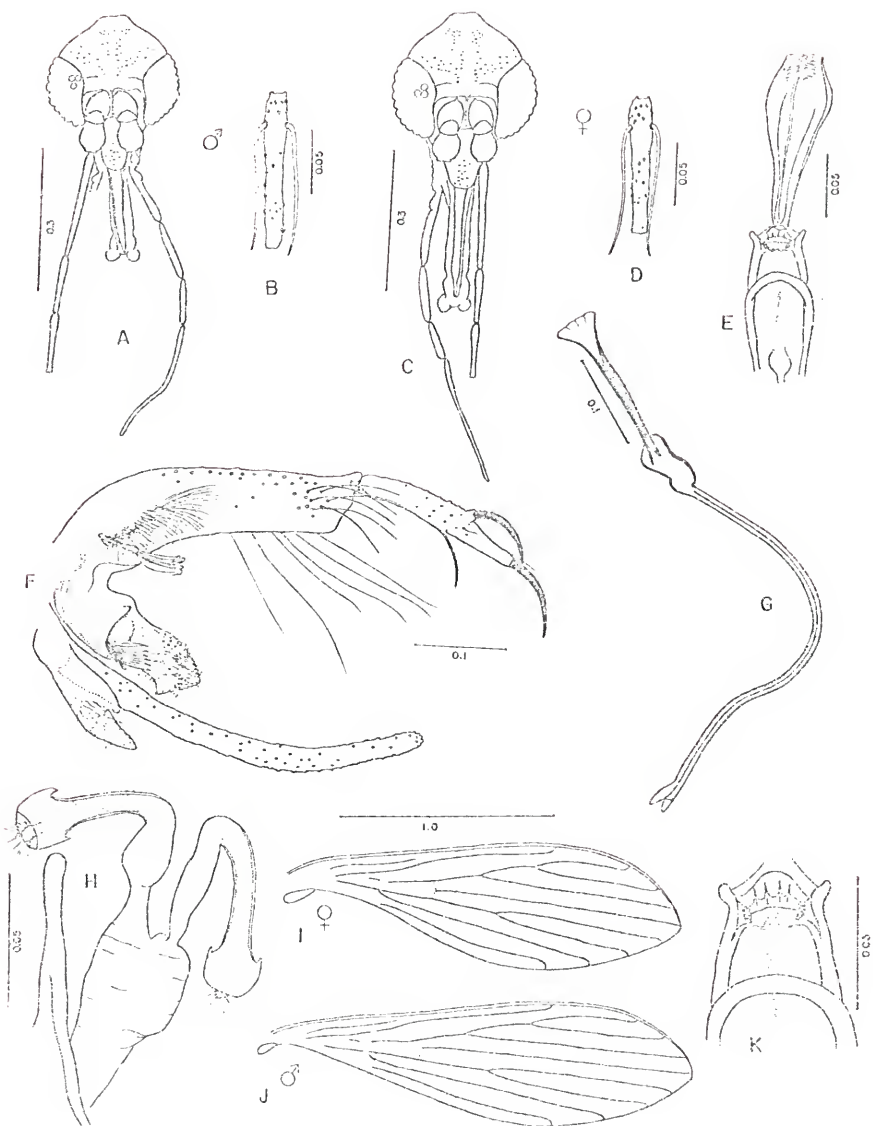


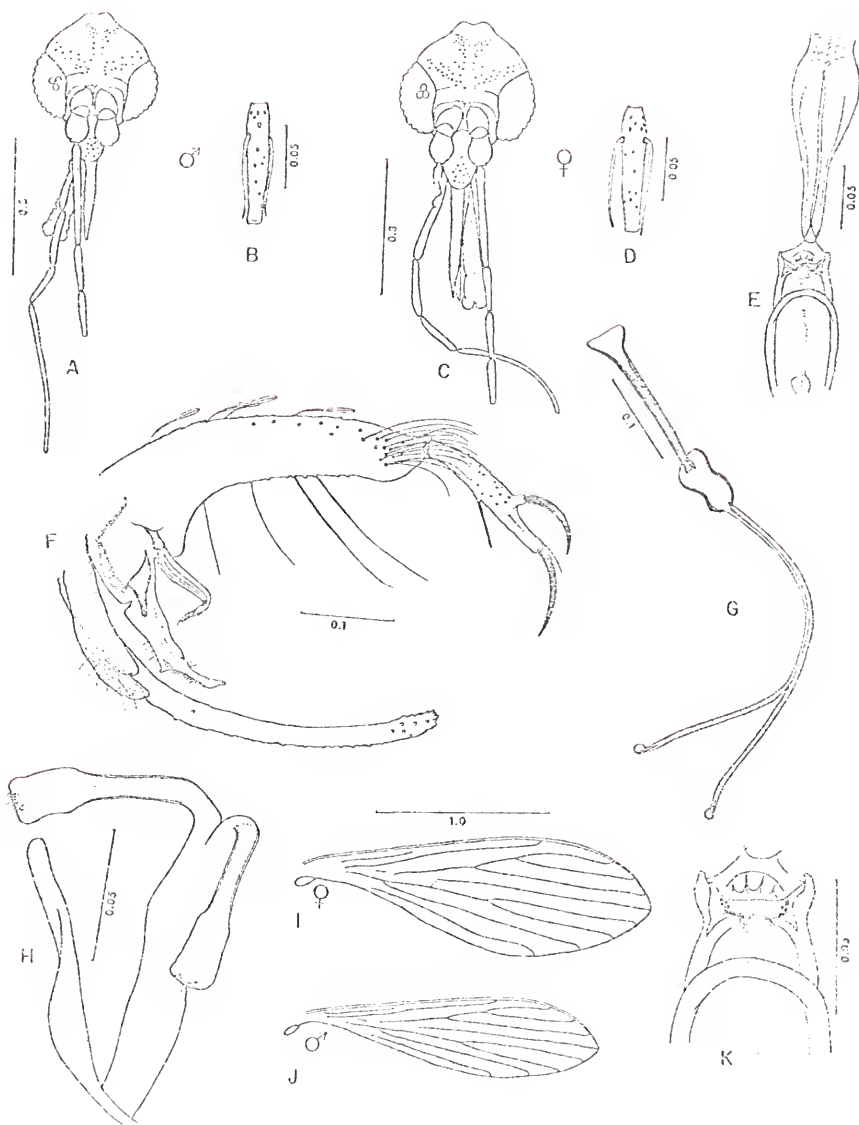
Figure 33

*Lutzomyia* (Pr.) *dysponeta* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, G. Genital pump and filaments, H. Spermathecae, I. Female wing, J. Male wing, K. Female cibarium.

Male: Teresita, Choco Dept., Colombia

Female: Same locality as male





Baityi Group Theodor, 1965

The two species comprising this group do not show obvious affinities to other *Lutzomyia* species and I prefer to separate them, unlike Forattini (1973) who places them in the subgenus *Coromyia* Barretto.

The female of *L. baityi* remains unknown but it probably resembles that of *L. gorbitzi* (Blancas) figured by Blancas (1959-1960), Fairchild & Hertig (1961b, as *hansonii*), and Theodor (1965). At present, only *L. baityi* is known to occur in Colombia but populations of *gorbitzi*, discovered in Darien Prov., Panama, may extend into Choco Department.

42. *Lutzomyia baityi*  
(Fig. 34)

*Phlebotomus baityi* Damasceno, Causy, & Arouck, 1945: 22 (♂ holotype, Cuiteua, Irituia, Para, Brazil). Barretto, 1947: 188-189 (listed). Damasceno et al., 1949: 819 (Brazilian records). Floch & Abonnenc, 1952: 34 (♂ keyed). Fairchild & Hertig, 1961b: 246 (cf. to *hansonii*). Pifano et al., 1962: 386 (♂ in key to Venezuelan spp.). Leon, 1968: 31-32 (♂ redescri., figs., Venezuela).

*Lutzomyia baityi*: Martins et al., 1963: 334 (Roraima, Brazil). Theodor, 1965: 194 (listed, fig.). Forattini, 1971a: 101 (listed). Forattini, 1973: 274 et seq. (gen. review, fig.).

*Distribution*: Colombia (Boyaca), Ecuador, Venezuela, Brazil.

*Material examined*: Colombia. 1 ♂ [UV], San Pablo de Borbur (Boyaca), tree hole, 10 March 1945, A. Cast. Brazil. 1 ♂, Boa Vista (Roraima), 16 Dec. 1960, J. Silva & L. Ferreira. Ecuador. 3 ♂♂, Rio Napo at Limoncocha (Napo), tree trunks, 18-22 May 1976, D.G.Y. & T. Rogers.

*Discussion:* The single Colombian male of *baityi*, examined by me through the kindness of Dr. Pablo Barreto, is housed in the collection at the University of Valle, Faculty of Medicine, Cali, Colombia. Future search will probably reveal its presence in other localities within the Republic, especially those in Amazonas.

Figure 34

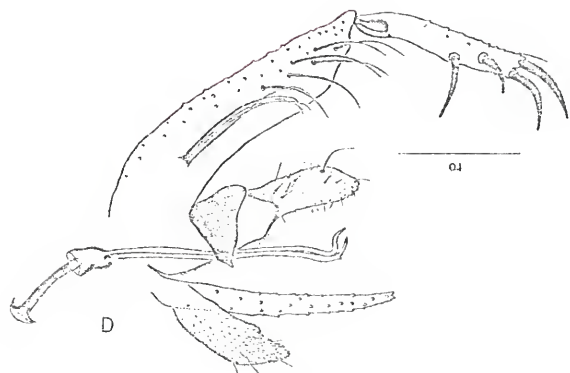
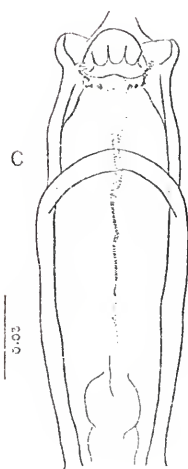
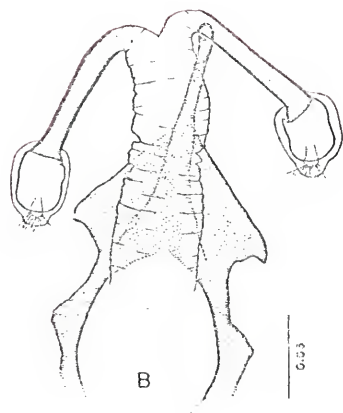
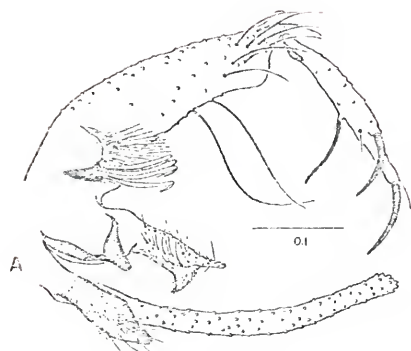
*Lutzomyia* (Pr.) *triasantha* -- A. Male genitalia, B. Spermathecae,  
C. Female cibarium.

Male: Limoncocha, Napo Prov., Ecuador

Female: Puerto Lleras, Meta Dept., Colombia

*Lutzomyia baityi* male -- D. Genitalia.

Male: Limoncocha, Napo Prov., Ecuador



Subgenus *Viannamyia* Mangabeira, 1941

This small distinctive group of four species is treated as a genus by Forattini (1971a, 1973). Three species occur in Colombia; the fourth, *L. fariasi* (Damasceno, Causey, and Arouck), is known from Brazil and French Guiana. The preferred hosts of these species remain unknown. Specimens are observed usually on tree trunks, sometimes in burrows and at light.

Keys to Species

Males

1. Style with both proximal spines inserted on long arm or process.  
Parameres relatively slender. . . . . 2  
  
Style with proximal spines inserted on separate processes or tubercles. Parameres broader. . . . . *tuberculata* (Fig. 36)
2. Parameres slender and downwardly turned apically. . *furcata* (Fig. 35)  
  
Parameres enlarged distally, shaped like a goat's head. . . . .  
. . . . . *caprina* (Fig. 35)

Females

1. Spermathecae cylindrical, associated sclerotized processes funnel-shaped. . . . . *tuberculata* (Fig. 36)  
  
Spermathecae oval, sclerotized processes subequal in width throughout  
. . . . . *caprina* (Fig. 35)  
  
*furcata*

43. *Lutzomyia* (V.) *caprina*  
(Fig. 35)

*Lutzomyia caprina* Osorno, Morales, & Osorno, 1972c: 437 (♂ holotype, vereda El Llano, Municip. Victoria, Caldas, Colombia; ♀, El Terminal, Municip. Puerto Boyaca, Boyaca, Colombia). Osorno et al., 1972a: 58 (Colombian records). Gomes, 1975: 8 (listed). Martins et al., 1976b: 496 (Peru).

*Phlebotomus furcatus* (not *furcatus* Mangabeira, 1941): Fairchild, 1943: 571 (Panama records).

*Phlebotomus arborealis* (not *arborealis* Floch & Abonnenc, 1944): Fairchild & Hertig, 1959: 121 (in part, Honduras & Panama records only). Johnson & Hertig, 1961: 765 et seq. (rearing data). Hanson, 1968: 48-50 (larva, pupa, descr., figs.). Thatcher, 1968a: 296 (♂, in Disney trap).

*Lutzomyia furcata* (not *furcatus* Mangabeira, 1941): Osorno et al., 1970: 11 (Boyaca, Colombia). Christensen & Fairchild, 1971: 302 (Darien, Panama). Christensen, 1972a: 88 (listed). Christensen & Herrero, 1973: 579 (in light traps, Panama).

*Lutzomyia arborealis* (not *arborealis* Floch & Abonnenc, 1944): Chaniotis et al., 1971a: 344 et seq. (pop. dynamics, Panama). Chaniotis et al., 1972: 95 (resting sites).

*Distribution:* Honduras, Panama, Colombia (Antioquia, Boyaca, Caldas, Choco), Peru.

*Material examined:* Colombia. 1 ♀, Rio Anori (Antioquia), tree buttress, 6 Feb. 1970, C.H.P. 1 ♂, 1 ♀, same data but Sept. 1970, D.G.Y. 1 ♀, Curiche (Choco), 27 July 1967, D.G.Y. 1 ♀, Alto Curiche (Choco), tree buttress, 31 May 1967, D.G.Y. 1 ♀ same data but light trap 27 Aug.

1967. 3 ♀♀, Teresita (Choco), light trap & tree buttresses, May & Sept.  
1967, D.G.Y. Honduras. 1 ♂, 4 ♀♀, Tela, Lancetilla Valley, light traps  
& tree buttresses, Dec. 1953 & Jan.-Feb. 1954, W. Hils. Panama. 10 ♂♂,  
20 ♀♀ from various localities in the Canal Zone, Bocas del Toro Prov.,  
Colon Prov., Darien Prov., & Panama Prov., tree buttresses & light or  
Shannon traps.

Discussion: See *L. furcata*.

44. *Lutzomyia* (V.) *furcata*  
(Fig. 35)

*Phlebotomus furcatus* Mangabeira, 1941b: 256 (♂ holotype, Aura,  
Belem, Para, Brazil). Barretto, 1947: 201 (refs.). Barretto, 1950a:  
104 (keyed). Barretto, 1951: 217 (Brazilian records). Floch & Abonnenc,  
1952: 31 (keyed), 78-80 (♂, redescr., figs., French Guiana). Fauran,  
1960: 8, 9 (mention). Forattini, 1960: 479 (Amapa, Brazil). Pifano  
et al., 1962: 383 (♂ keyed).

*Phlebotomus arborealis* Floch & Abonnenc, 1944a: 8 (♀, Baduel,  
French Guiana). Barretto, 1947: 186 (refs.). Floch & Abonnenc, 1952:  
43 (keyed), 179-181 (redescr., figs.). Fairchild, 1955: 190 (as probable  
♀ of *furcatus*). Fauran, 1960: 9 (mention).

*Lutzomyia furcata*: Barretto, 1962: 94 (listed). Martins et al.,  
1963: 334 (Roraima, Brazil). Martins et al., 1965: 3 (Rondonia,  
Brazil). Wijers & Huisenga, 1967: 397 (cf. to *tuberculata*). Osorno et  
al., 1972a: 58-59 (Colombian records). Osorno et al., 1972c: 441 (cf.  
to *caprina*). Shaw & Lainson, 1972: 713 (mention). Lewis, 1975a: 502  
et seq. (mouthpart morphol.). Llanos et al., 1976: 480 (Peru). Lainson  
et al., 1977 (Mato Grosso, Brazil).



*Lutzomyia arborealis*: Barretto, 1962: 94 (as synonym of *furcata*).

*Viannamyia furcata*: Forattini, 1971a: 106 (listed). Forattini, 1973: 123 et seq. (in part, refs. based on material from Panama not *furcata* Mang., gen. review, figs.).

*Distribution*: Brazil, French Guiana, Venezuela, Peru, Colombia (Caqueta, Santander).

*Material examined*: Colombia. 1 ♂ (INPES no. 3825), Vereda La Nevera, Solano (Caqueta), tree hole, 25 Aug. 1969. Brazil. 1 ♂, 1 ♀, Serra do Navio (Amapa), tree trunks, 21 Sept. 1972, D.G.Y. & H. Fraiha. 1 ♂, 2 ♀♀, Labrea (Amazonas), tree trunk, 9 Oct. 1972, D.G.Y. 2 ♂♂, 2 ♀♀, Rio Aripuana at Humboldt (Mato Grosso), tree trunks, 17-20 Aug. 1974, D.G.Y., J. Shaw, & H. Fraiha. 1 ♂, Belem (Para), 3 Aug. 1964, F. Guimaraes. 1 ♀, same locality, light trap, 18 Aug. 1972, D.G.Y. 2 ♀♀, same locality, flight traps, 29 July-6 Aug. 1974, D.G.Y. 1 ♀, Itiatuba (Para), light trap, 4 Oct. 1972, D.G.Y. 1 ♀, 27 km E of Maraba (Para), light trap, 27 Sept. 1972, D.G.Y. & H. Fraiha. 1 ♂, 1 ♀, W of Altamira, km 164 (Para), tree trunk, 9 Nov. 1974, J. Reinert.

*Discussion*: The distal part of the parameres of *L. furcata* (description of Mangabeira, 1941b, and males from Brazil, French Guiana, and Caqueta, Colombia) is long and slender, downwardly curved with a short, stout apical spine (Fig. 35G). In contrast, the parameres of *L. caprina* (description of Osorno et al., 1972c, and male from Antioquia, Colombia) are broader apically and lack a stout terminal spine (Fig. 35H). The occurrence of *caprina* in Loreto Prov., Peru (Martins et al., 1976b) suggests that it and *furcata* are distinct taxa. The females, however, from these and all other localities are morphologically inseparable, the record of *furcata* (♀ only) in Antioquia Dept. (Osorno et al., 1972a) probably representing not that species but *L. caprina*.

Without additional material from Central America, the identity of the specimens from Panama and Honduras remains uncertain. Panamanian males generally resemble *caprina* in the shape of the parameres but each terminates in an apical spine, longer than that of *furcata*. The male from Honduras, on the other hand, more closely resembles *furcata* in paramere shape but again the apical spine is much longer. It is difficult to determine whether or not these character states reflect inter or intraspecific variation but for the present I arbitrarily treat specimens from Panama and Honduras as variants of *caprina*, primarily on the basis of distribution.

*Lutzomyia furcata* was included in a key to the phlebotomines of Venezuela (Pifano et al., 1962) but no additional information was given.

45. *Lutzomyia* (V.) *tuberculata*  
(Fig. 36)

*Phlebotomus tuberculatus* Mangabeira, 1941b: 251 (♂ holotype, Aura, Belem, Para, Brazil). Barretto, 1947: 227 (refs.). Damasceno et al., 1948: 699 (cf. to *fariasi*). Damasceno et al., 1949: 833 (Brazilian records). Barretto, 1950a: 104 (keyed). Barretto, 1951: 225 (distrib.). Floch & Abonnenc, 1952: 31 (keyed). Fauran, 1960: 8-9 (♂, redescri., figs.).

*Phlebotomus* sp. x Floch & Abonnenc, 1944a: 10-12 (♀, French Guiana). Floch & Abonnenc, 1952: 43 (keyed), 181 (redescri., figs.). Barretto, 1962: 94 (as female of *tuberculata*).

*Lutzomyia tuberculata*: Barretto, 1962: 94 (listed). Martins et al., 1963: 335 (Roraima, Brazil). Theodor, 1965: 190 (♂, ♀, figs.). Barreto, 1969: 467 (Valle, Colombia). Lewis et al., 1970: 215 (ovaries

& accessory glands). Christensen 1972a: 88 (Panama). Osorno et al., 1972a: 59 (Colombian records). Lewis, 1975a: 502 et seq. (mouthpart morphol.). Lainson et al., 1977 (Mato Grosso, Brazil).

*Lutzomyia munangai* Wijers & Huisenga, 1967: 395 (♂ holotype, near Moengo, Surinam). Lewis, 1975a: 511 (as synonym of *tuberculata*).

*Viannamyia munangai*: Forattini, 1971a: 106 (listed). Forattini, 1973: 516 (cf. to *tuberculata*). Gomes, 1975: 8 (listed).

*Viannamyia tuberculata*: Forattini, 1971a: 106 (listed). Forattini, 1973: 507 et seq. (gen. review, figs.). Gomes, 1975: 8 (listed).

*Distribution*: Panama, Colombia (Antioquia, Caqueta, Choco, Valle), French Guiana, Surinam, Brazil.

*Material examined*: Colombia. 1 ♀, Rio Anori (Antioquia), tree trunk, 4 March 1971, C.H.P. 1 ♀, Curiche (Choco), Malaise trap, 25 July 1967, D.G.Y. 2 ♀♀, Alto Curiche (Choco), 7 July 1967, D.G.Y. 1 ♀, Anchicaya Dam (Valle), tree trunk, 9 Aug. 1973, D.G.Y. & R.C.W. 6 ♂♂, 8 ♀♀, 25 km E of Buenaventura (Valle), tree trunks & light trap, 11-12 Aug. 1973, D.G.Y. & R.C.W. Brazil. 2 ♀♀, Serra do Navio (Amapa), tree trunks, 21 Sept. 1972, D.G.Y. & H. Fraiha. 1 ♀, W of Altamira (Para), light trap, 1 Oct. 1972, D.G.Y. 2 ♀♀, Belem (Para), light trap, 18 Oct. 1972, D.G.Y. 2 ♂♂, 5 ♀♀, Belem (Para), tree trunks, flight trap, 29-31 July, 1974, D.G.Y. 3 ♂♂, 2 ♀♀, Rio Aripuana at Humboldt (Mato Grosso), tree trunks, 16-19 Aug. 1974, D.G.Y., J. Shaw, & H. Fraiha. Panama. 2 ♀♀, Almirante (Bocas del Toro), Aug.-Sept. 1951, A. Quinones.

*Discussion*: *Lutzomyia tuberculata*, a little known species, is not considered to be anthropophilic although Barreto (1969) reported the capture of a single female on man in Valle Dept., Colombia. Both sexes are easily recognized.

Figure 35

*Lutzomyia (V.) caprina* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, H. Tip of paramere of male from Rio Anori, Antioquia Dept., Colombia, I. Genital pump and filaments, J. Spermathecae, K. Female wing, L. Male wing, M. Female cibarium.

Male: Panama Canal Zone (except Fig. 35H)

Female: Curiche, Choco Dept., Colombia

*Lutzomyia (V.) furecata* -- G. Tip of paramere.

Male: Para State, Brazil

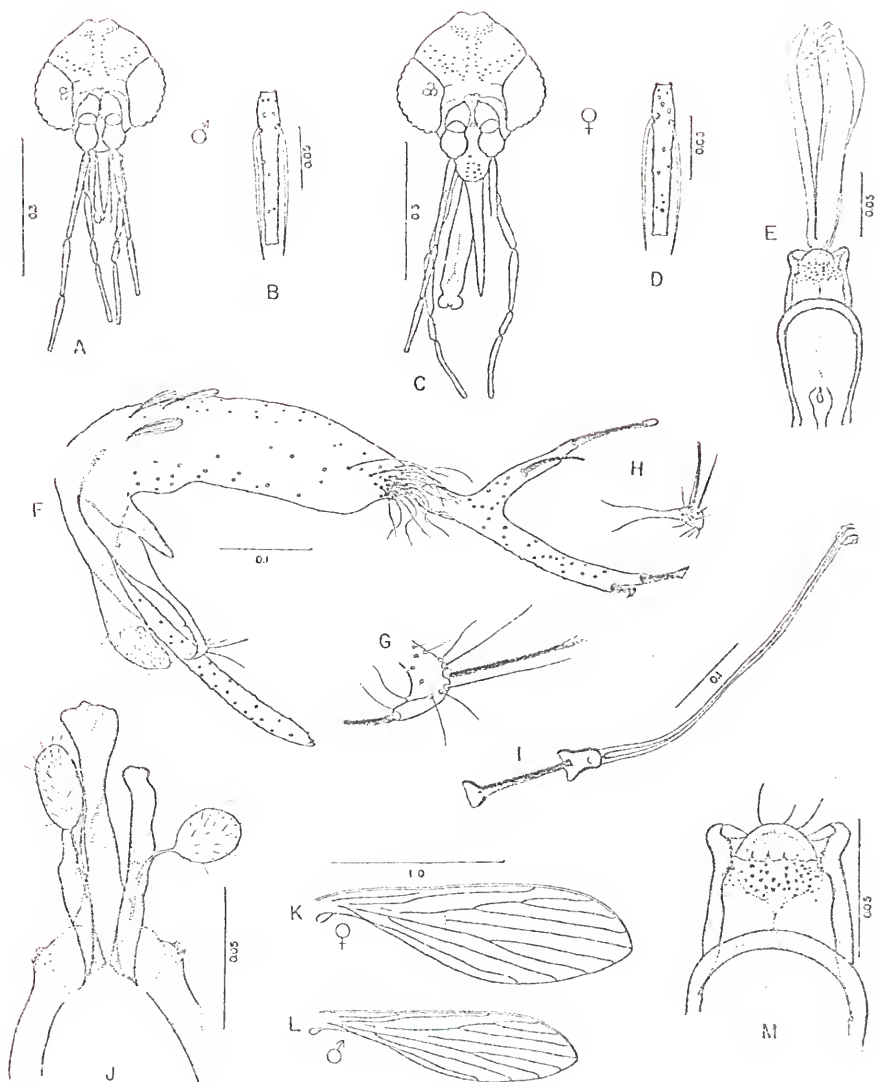


Figure 36

*Lutzomyia (V.) tuberculata* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, G. Spermathecae, H. Female wing, I. Male wing, J. Female cibarium.

Male: Valle Dept., Colombia

Female: Curiche, Choco Dept., Colombia



Shannoni Group Theodor, 1965

Barretto (1962) created the subgenus *Psathyromyia* to accomodate *L. shannoni* and its allies, some of which (the *aragaoi* group species) were separated later by Theodor (1965). Based on both sexual and non-sexual characters, the *shannoni* and *aragaoi* species are very similar as noted by Fairchild (1955) and Barretto (1962).

Forattini (1971a, 1973), for reasons not fully understood, places the species in the *aragaoi* group in the genus *Psychodopygus* but retains *L. shannoni* and its relatives in the genus *Lutzomyia* in the expanded subgenus *Trichopygomyia* Barretto. This seems to be unnecessarily artificial and I prefer to follow the arrangement of Theodor (1965) and Lewis et al. (1978).

Six of the 14 described *shannoni* group species occur in Colombia but others such as *L. lutziana* (Costa Lima), *L. campbelli* (Damasceno, Causey & Arouck), and possibly *L. scafffi* (Damasceno & Arouck) may eventually be discovered in the Amazonian region of the Republic.

Keys to Species

Males

1. Paramere with a basal tuft of long setae implanted on a short dorsal process . . . . . *dasymera* (Fig. 38)  
  
Paramere simple, lacking a setiferous dorsal process. . . . . 2
2. Antennal ascoids with short, blunt posterior spurs. . . . .  
. . . . . *punctigeniculata* (Fig. 40)  
  
Antennal ascoids with long pointed posterior spurs. . . . . 3



3. Paramere with sinuous dorsal setae. . . . . *undulata* (Fig. 42)
- Paramere without such dorsal setae. . . . . 4
4. Paramere with dorsal setae restricted to apical third of structure  
. . . . . *abonnenci* (Fig. 37)
- Paramere with dorsal setae covering at least the apical half of  
structure . . . . . 5
5. Paramere as in Fig. 39A. The apical dorsal setae slightly foliaceous  
and recurved unlike the shorter proximal setae. *dendrophyla* (Fig. 39)
- Paramere otherwise (Fig. 41G), the dorsal setae unmodified, more or  
less erect. . . . . *shannoni* (Fig. 41)

Females

1. Cibarium with 6+ horizontal teeth . . . . . 2
- Cibarium with 4 horizontal teeth\* . . . . . *shannoni* (Fig. 41)
- dendrophyla* (Fig. 39)
- abonnenci*
2. Spermathecae annulated. . . . . *undulata* (Fig. 42)
- Spermathecae smooth-walled, without annulations . . . . . 3

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\*Morales et al. (1974) noted that the common sperm duct of *dendrophyla* is shorter than that of *shannoni* (0.049-0.099 mm as opposed to 0.145-0.198 mm). This may be helpful in separating the taxa but without associated males I hesitate to identify females to species.

3. Antennal ascoid with short blunt posterior spur. Individual sperm duct about half length of common duct and less than 2 x length of spermatheca . . . . . *punctigeniculata* (Fig. 40)

Antennal ascoid with long pointed posterior spur. Individual sperm duct much longer than common duct and over 3 x length of spermatheca . . . . . *dasymera* (Fig. 38)

46. *Lutzomyia abonnenci*  
(Fig. 37)

*Phlebotomus abonnenci* Floch & Chassignet, 1947c: 1 (♂ holotype, Baduel, near Cayenne, French Guiana). Floch & Chassignet, 1948: 3 (listed). Fairchild & Hertig, 1950: 526 (as a variant of *shannoni*, fig.). Barretto, 1951: 211 (Brazilian record). Floch & Abonnenc, 1952: 38 (keyed), 151-152 (♂, redescr., figs.). Barretto & Duret, 1953: 344 (cf. to *microcephalus*). Rosabal, 1954: 21 (mention). Deane & Deane, 1957: 225 et seq. (Ceara, Brazil). Fairchild & Hertig, 1961b: 242 (mention). Sherlock, 1962: 322 (Rio Caqueta, Colombia). Sherlock & Carneiro, 1964: 206, 207 (reproductive system).

*Lutzomyia abonnenci*: Barretto, 1962: 99 (listed). Martins et al., 1965: 2 (Rondonia, Brazil). Forattini, 1971a: 2 (as a synonym of *shannoni*). Osorno et al., 1972a: 49 (Colombian records). Christensen, 1972a: 88, 89 (as a valid species). Forattini, 1973: 102 (as a synonym of *shannoni*). Llanos et al., 1976: 480 (Peru). Miles et al., 1976: 532 (mating aggregation, Panama).

*Distribution*: Panama, Colombia (Antioquia, Bolivar, Boyaca, Caldas, Caqueta, Choco, Norte de Santander, Santander), Peru, French Guiana, Brazil.

*Material examined:* *Colombia*. 1 ♂, Rio Anorí (Antioquia), light trap, May 1970, C.H.P. 31 ♂♂ same data but tree trunks, Sept. 1970, D.G.Y. 19 ♂♂, Curiche (Choco), tree trunks July, Sept.-Nov. 1967, D.G.Y. 5 ♂♂, Alto Curiche (Choco), tree trunks, July 1967, D.G.Y. 29 ♂♂, Teresita (Choco), tree trunks, March, May-Nov. 1967, D.G.Y. *Brazil*. 1 ♂, 27 km SE of Maraba (Para), tree trunk, 26 Sept. 1972, D.G.Y. & H. Fraiha.

*Discussion:* Based on rearing studies, Christensen (1972a) demonstrated that *L. abbonenci* and *L. shannoni* are valid species, the females of each morphologically indistinguishable. Specimens of both species are found usually on or in trees in lowland forests but *shannoni* is more widely distributed.

47. *Lutzomyia dasymera*  
(Fig. 38)

*Phlebotomus dasymerus* Fairchild & Hertig, 1961b: 242 (♂ holotype, Mojinga Swamp, Canal Zone; ♀, Camp Pina, Canal Zone). Rosabal, 1966: 1 (Costa Rica). Leon, 1968: 31 et seq. (♂, redescr., figs., Venezuela). Hanson, 1968: (first instar larva, descr., fig.).

*Lutzomyia dasymera*: Barretto, 1962: 99 (listed). Theodor, 1965: 193-194 (in *castanheirai* group). Barreto, 1969: 464 (Valle, Colombia). Sherlock & Guitton, 1970: 140 (classif.). Forattini, 1971a: 102 (listed). Chaniotis et al., 1971a: 344 et seq. (pop. dynamics, Panama). Christensen, 1972a: 88 (listed). Christensen et al., 1972: 57 (collecting data). Chaniotis et al., 1972: 95 (in tree holes). Osorno et al., 1972a: 62 (Colombian records). Christensen & Herrero, 1973: 579 (listed). Forattini, 1973: 293 et seq. (gen. review, figs.). Llanos et al., 1975a: 657 (♀ cf. to *campbelli*).

*Distribution:* Mexico, Nicaragua, Costa Rica, Panama, Colombia (Antioquia, Boyaca, Choco, Valle), Venezuela.

*Material examined:* Colombia. 1 ♀, Curiche (Choco), tree buttress, 5 July 1967, D.G.Y. 2 ♂♂, same data but 22 Sept. 1967. 1 ♂, Rio Anori (Antioquia), tree buttress, 16 Sept. 1970, D.G.Y. Mexico, Nicaragua, Costa Rica, Panama. Specimens listed by Fairchild & Hertig, 1961b, including holotype and allotype.

*Discussion:* I include *L. dasymera* in the *shannoni* group because of the cylindrical spermathecae, the position of the major spines of the style, lack of nondeciduous setae on the coxite, long posterior spurs of the ascoids, relative lengths of the palpal segments, and larval characteristics (Hanson, 1968). Like most other *shannoni* group species, *L. dasymera* is often found resting in or on trees.

This species and *L. campbelli* (Damasceno, Causey, and Arouck) are closely related but apparently do not occur together, the latter known from French Guiana, Brazil, Peru, and Bolivia. The female of *campbelli*, recently described by Llanos et al. (1975a) resembles that of *dasymera* but there are 6 instead of 8+ horizontal teeth in the cibarium and the individual sperm ducts are partly striated unlike those of *dasymera* which are smooth-walled.

48. *Lutzomyia dendrophyla*  
(Fig. 39)

*Phlebotomus dendrophylus* Mangabeira, 1942a: 139 (♂ holotype, Aura, Belem, Para, Brazil). Barretto, 1947: 197 (listed). Damasceno et al., 1949: 824 (Brazilian records). Barretto, 1950a: 111 (♂ keyed). Barretto, 1951: 216 (distrib.). Floch & Abonnenc, 1952: 20 et seq.

(♂, keyed, redescri.). Barretto & Duret, 1953: 344 (cf. to *microcephalus*). Vargas & Díaz-Nájera, 1959: 146 (mention). Forattini, 1960: 476 (Amapa, Brazil). Pifano et al., 1962: 385 (♂ keyed). Ortiz, 1965c: 416 (mention). Ortiz, 1972a: 23, 24 (listed). Pifano et al., 1973: 158 (mention).

*Lutomyia dendrophila* (or *dendrophyla*): Barretto, 1962: 99 (listed). Martins & Silva, 1964: 128 (Acre, Brazil). Martins et al., 1965: 2 (Rondonia, Brazil). Lewis et al., 1970: 215 (parous rates). Forattini, 1971a: 102 (listed). Osorno et al., 1972a: 51 (Colombian records). Martins & Morales, 1972: 367 (listed). Llanos, 1973: 30 (Peruvian record). Forattini, 1973: 293 et seq. (gen. review, figs.). Velasco, 1973: 85 (Bolivia). Morales et al., 1974: 443 (♀ descr., figs., Colombia). Ward & Killick-Kendrick, 1974: 216 (Para, Brazil). Lewis, 1975a: 502 et seq. (mouthpart morphol.). Llanos et al., 1975b: 670 (Peru). Ward & Ready, 1975: 128 et seq. (egg structure). Llanos et al., 1976: 480 (Peru). Martins et al., 1976b: 496 (Peru). Lainson et al., 1977 (Mato Grosso, Brazil).

*Distribution:* Colombia (Amazonas, Caqueta, Meta), Ecuador, Peru, Bolivia, Venezuela, French Guiana, Brazil.

*Material examined:* Colombia. 7 ♂♂, 9 ♀♀, 17 km W of Leticia (Amazonas), tree trunks, 24-26 July 1973, D.G.Y. & R.C.W. Bolivia. 1 ♂, 1 ♀, 5 km N of Tajlewi (Larecaja), tree trunks, 13 Aug. 1971, J. Velasco. 1 ♂, 1 ♀, Misquimayo (Sud Yungas), chicken coop, 1700 m above sea level, 3 Sept. 1971, J. Velasco. Brazil. (all on tree trunks). 5 ♂♂, Serra do Navio (Amapa), 21 Sept. 1972, D.G.Y. & H. Fraiha. 12 ♂♂, Labrea (Amazonas), 9-10 Oct. 1972, D.G.Y. 72 ♂♂, Rio Aripuana at Humboldt (Mato Grosso), 13-20 Aug. 1974, D.G.Y., J. Shaw, & H. Fraiha. 3 ♂♂, 27 km

SE of Maraba (Para), 26-28 Sept. 1972, D.G.Y. & H. Fraiha. 1 ♂, W of Altamira (Para), 1 Oct. 1972, D.G.Y. 5 ♂♂, Belem (Para), 29 July-1 Aug. 1974, D.G.Y. Ecuador. 90 ♂♂, Rio Napo at Limoncocha (Napo), tree trunks, 19-24 May 1976, D.G.Y. & T. Rogers. French Guiana. 1 ♂, Baduel, Dec. 1947, no other data. Peru. 2 ♂♂, Cachicote (Huanuco), 12 Sept. 1965, J. Hitchcock.

*Discussion:* *Lutzomyia dendrophyla* is an Amazonian species which occurs often but not always with *L. shannoni* where their ranges overlap. We collected only *dendrophyla* at Leticia, the spermathecae (Fig. 39B) drawn from a female taken from there. The females of both species occasionally bite man (Lainson et al., 1977; Forattini, 1973) and are very difficult to separate in the absence of associated males.

49. *Lutzomyia punctigeniculata*  
(Fig. 40)

*Phlebotomus punctigeniculatus* Floch & Abonnenc, 1944b: 5 (♂ holotype, near Cayenne, French Guiana). Barretto, 1947: 220 (refs.). Floch & Abonnenc, 1948b: 1, 12, 24 (Venezuela, ♂, figs.). Damasceno et al., 1949: 831 (Brazilian records). Fairchild & Hertig, 1950: 524 et seq. (measurements, taxonomy, figs.). Barretto, 1951: 222 (distrib.). Pifano & Ortiz, 1952: 144, 146 (keyed). Floch & Abonnenc, 1952: 37, 46 (keyed), 153 (♂, ♀, redescr.). Barretto & Duret, 1953: 344 (mention). Pifano et al., 1962: 385, 388 (♂, ♀, keyed), 397 (♂, ♀, redescr., refs., figs., Venezuela). Ortiz, 1965c: 416 (mention). Leon, 1968: 30 (listed). Ortiz, 1972a: 23 (mention). Pifano et al., 1973: 158 (mention).

*Phlebotomus christophersoni* Damasceno & Causey, 1944: 347 (♂ holotype, Santarem, Para, Brazil). Fairchild & Hertig, 1950: 526 (as a synonym of *punctigeniculata*).

*Lutzomyia punctigeniculata*: Barretto, 1962: 99 (listed). Martins et al., 1962a: 381 (Goiás, Brazil). Martins et al., 1963: 335 (Roraima, Brazil). Forattini, 1971a: 102 (listed). Tesh et al., 1971a: 153 (blood meal from edentate). Chaniotis et al., 1971a: 344 et seq. (pop. dynamics, Panama). Chaniotis et al., 1972: 95 (on or in trees). Osorno et al., 1972a: 51-52 (Colombian records). Llanos, 1973: 33 (♂, redescr., figs., Peru). Forattini, 1973: 293 et seq. (gen. review, figs.). Velasco, 1973: 87 (♀ with 8 horizontal teeth, Bolivia). Morales et al., 1974: 445 (cf. to *dendrophyla*). Lewis, 1975a: 502 et seq. (mouth-part morphol.). Llanos et al., 1975b: 671 (Peru). Martins et al., 1976b: 496 (Peru).

*Distribution*: Panama, Colombia (Bolívar, Boyacá, Caldas, Caquetá, Chocó, Guajirá, Huila, Magdalena, Tolima), Peru, Bolivia, Brazil, French Guiana, Venezuela.

*Material examined*: Colombia. 1 ♂, Curiche (Chocó), tree buttress, 15 Aug. 1967, D.G.Y. 1 ♀, Rio Don Diego, E of Santa Marta (Magdalena), tree trunk, 15 Aug. 1973, D.G.Y. & R.C.W. Bolivia. 4 ♂♂, Suiqui (Sud Yungas), sheep pen, 1700 m, 25 June 1971, J. Velasco. 2 ♂♂, Tajlewi (Iarecaja), tree buttress, 500 m, 13 Aug. 1971, J. Velasco. Panama. 9 ♂♂, 1 ♀, Chorrera (Panama), tree roots, 7 April 1944, G. Fairchild.

*Discussion*: *Lutzomyia punctigeniculata*, the only *shannoni* group species with short, blunt posterior spurs on the ascoids, is widespread in Colombia, specimens often being discovered in or on trees or less commonly in light traps.

The male resembles *L. scafffi* (Damasceno & Arouck), known from Brazil and Peru, in the shape of the genitalia but the ascoids of that species have long, pointed posterior spurs. The female of *scafffi*, discovered but undescribed (unpublished data) resembles that of *punctigeniculata* in spermathecae and color (pleura moderately infuscated) but there are only 4 horizontal teeth in the cibarium.

50. *Lutzomyia shannoni*  
(Fig. 41)

*Phlebotomus shannoni* Dyar, 1929: 121 (♂, Cano Saddle, Gatun, Canal Zone). Barretto, 1947: 222-223 (full refs., synonyms). Fairchild & Hertig, 1950: 523 et seq. (collecting data, review of habits, ♂, ♀, figs.). Forattini, 1954: 214 et seq. (sternites, figs.). Fairchild & Hertig, 1959: 122-124 (distrib.). Johnson & Hertig, 1961: 765 et seq. (rearing data). Hanson, 1968: 78 (larva, pupa, descr., figs.). Morales et al., 1969a: 380 (Meta, Colombia).

*Lutzomyia shannoni*: Martins et al., 1961b: 311 (Brazil). Theodor, 1965: 189 (listed, ♂, ♀, figs.). Osorno et al., 1972a: 52-57 (Colombian records). Forattini, 1973: 84 et seq. (gen. review, refs., figs.). Zeledon & Alfaro, 1973: 416 (infected with promastigotes). Ward et al., 1973: 178 (biting man, Para, Brazil). Morales et al., 1974: 445-446 (o cf. to *dendrophyla*). Williams, 1976a: 604 (in caves, Belize). Miles et al., 1976: 532 (mating aggregation, Panama).

*Distribution*: SE United States to Paraguay, Colombia (Antioquia, Bolivar, Boyaca, Caldas, Caqueta, Choco, Cundinamarca, Guajira, Magdalena, Norte de Santander, Santander, Tolima, Valle).

*Material examined*: Colombia. 2 ♂♂, Rio Anori (Antioquia), light traps, May 1970, C.H.P. 14 ♂♂, 22 ♀♀, same data but tree trunks, Sept.



1970, D.G.Y. 238 ♂♂, 164 ♀♀, Curiche (Choco), light Malaise, & Shannon traps, biting man & tree trunks, April-Dec. 1967, D.G.Y. 2 ♂♂, 6 ♀♀, Alto Curiche (Choco), tree trunks & Shannon trap, May, July-Aug. 1967, D.G.Y. 268 ♂♂, 167 ♀♀, Teresita (Choco), light, Malaise, & Shannon traps, tree trunks, March-Dec. 1967, D.G.Y. 1 ♂, 1 ♀, Rio Don Diego, E of Sant Marta (Magdalena), tree trunk, 15 Aug. 1973, D.G.Y. & R.C.W. 7 ♂♂, Minca, SE of Santa Marta (Magdalena), tree trunks, 17 Aug. 1973, D.G.Y. & R.C.W. 13 ♂♂, 2 ♀♀, Pichinde, W. of Cali (Valle), tree trunks, 31 July-2 Aug. 1973, D.G.Y. & R.C.W. 2 ♂♂, 1 ♀, Rio Pance near Cali (Valle), tree trunks 7 Aug. 1973, D.G.Y. & S. Ayala. *Ecuador*. 18 ♂♂, Rio Napo at Limonchocha (Napo), tree trunks, 19-24 May 1976, D.G.Y. & T. Rogers. 26 ♂♂, 10 ♀♀, 17 km E of Santo Domingo de los Colorados (Pichincha), 5 May 1976, D.G.Y. *Brazil, Costa Rica, Nicaragua, Panama, United States and Venezuela*, numerous specimens of both sexes in UF collection.

*Discussion:* There are numerous references to this species, most of which were reviewed by Barretto (1947) and Forattini (1973). It is not necessary to repeat all of them here.

*Phlebotomus limai* Fonseca and *P. bigeniculatus* Floch & Abonnenc, are well established synonyms of *shannoni*. The taxon described as *P. microcephalus* Barretto & Duret, from Argentina also may be conspecific with *shannoni*, as Forattini (1973) believes, but I have not seen specimens from Argentina and therefore cannot evaluate its status.

*L. shannoni*, the most widespread phlebotomine species in the Americas, feeds on mammals (including man), birds, and reptiles, and/or amphibians (Forattini, 1973; Tesh et al., 1971a). Subsequent host

preference studies in Panama (Tesh et al., 1972) revealed that 78.5% of 312 blood meals reacted with rodent antiserum. At Curiche, we collected only one *shannoni* female biting man from April to November 1967 (141 man hours). As expected, most specimens (232 ♂♂, 155 ♀♀) were captured on tree trunks where only *L. trinidadensis* was taken in greater numbers (333 ♂♂, 301 ♀♀) during the same time period.

51. *Lutzomyia undulata*  
(Fig. 42)

*Phlebotomus undulatus* Fairchild & Hertig, 1950: 527 (♂ holotype, near Esquintla, Guatemala). Vargas & Diaz-Nájera, 1953b: 313 (Mexico). Fairchild & Hertig, 1959: 122 (Central American records). Fairchild & Hertig, 1961b: 244 (cf. to *cratifer*). Rosabal & Trejos, 1965: 222 (listed). Thatcher, 1968a: 296 (♂♂ in Disney trap).

*Phlebotomus humboldti* Vargas & Diaz-Nájera, 1959: 143 (♂, ♀, Oaxaca, Mexico). Rosabal & Trejos, 1964: 169 (as synonym of *undulatus*).

*Lutzomyia undulata*: Barretto, 1962: 99 (listed, as synonym of *humboldti*). Williams, 1970: 333 et seq. (Belize, negative for flagellates). Chaniotis et al., 1971a: 344 et seq. (pop. dynamics, Panama). Forattini, 1971a: 102 (listed). Tesh et al., 1971a: 152 (blood meals). Tesh et al., 1972: 90 (blood meals). Martins & Morales, 1972: 365 (listed). Chaniotis et al., 1972: 95 (resting on or in trees). Christensen, 1972a: 88 (listed). Christensen et al., 1972: 57 (collecting data). Forattini, 1973: 294 et seq. (gen. review, figs.). Christensen & Herrer, 1973: 579 (in light trap).

*Lutzomyia cratifera*: Osorno et al., 1972a: 61 (not *cratifer* Fairchild & Hertig, 1961b, Boyaca, Colombia).

*Distribution:* Mexico, Guatemala, Belize, El Salvador, Panama, Colombia (Boyaca, Choco, Narino), Ecuador.

*Material examined:* Colombia. 1 ♀, Curiche (Choco), tree buttress, 15 Aug. 1967, D.G.Y. 1 ♂, 2 ♀♀, Rio Aguacalara, Tumaco (Narino), light trap, 21 July 1969, P. Barreto. Ecuador. 1 ♀, 17 km E of Santo Domingo de los Colorados (Pichincha), tree trunk, 27 May 1976, D.G.Y. Guatemala. 3 ♂♂ (paratypes & holotype), near Esquintla, tree buttresses, May, June, 1945. Panama. 1 ♂, Rio Tuira at mouth of Rio Paya (Darien), Shannon trap, 25 Feb. 1958, P. Galindo.

*Discussion:* *Lutzomyia undulata* is generally rare throughout its range, the relatively few specimens having been captured in or on trees and in light traps. Using the precipitin test, Tesh et al. (1971a, 1972) in Panama found that blood meals from recently engorged females reacted with antisera from rodents, marsupials, and carnivores.

The females of *undulata* and *L. cratifer* (Fairchild & Hertig) are morphologically inseparable, the record of the latter species in Colombia (Osorno et al., 1972a) probably referring to *undulata*, the males of which have been found in Colombia and Panama. Males of *cratifer* are known only from Mexico and Honduras.

Figure 37

*Lutzomyia abonnenci* male -- A. Head, B. Flagellomere II, C. Wing,  
D. Genitalia, E. Genital pump and filaments.

Male: Teresita, Choco Dept., Colombia

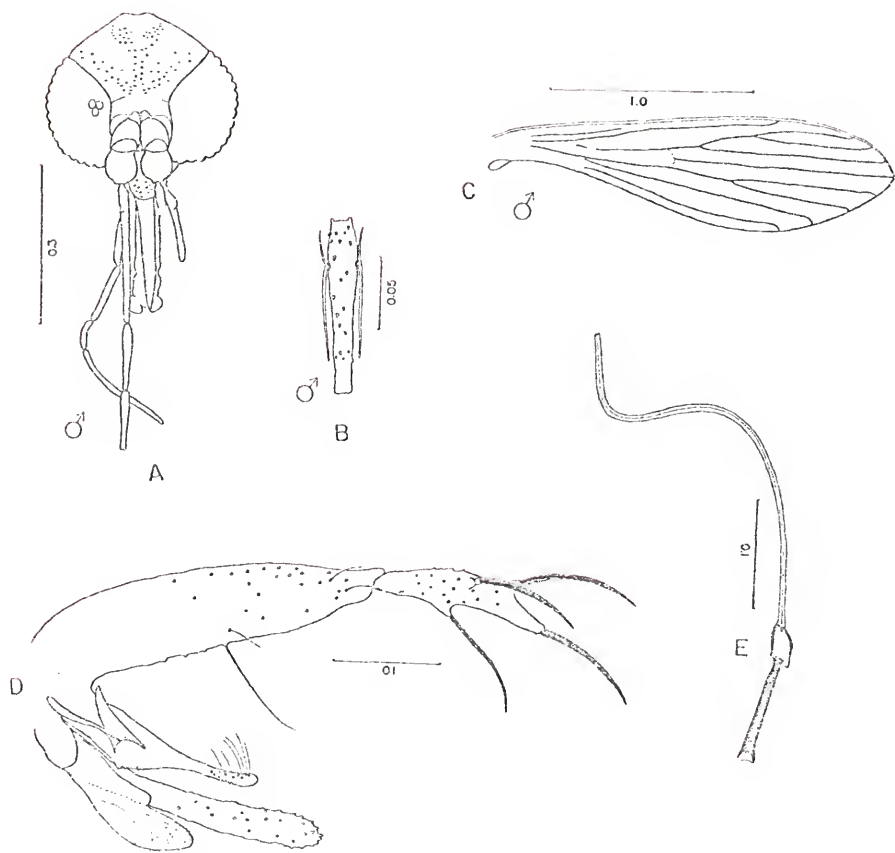


Figure 38

*Lutromyia dasymera* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Genital pump and filaments, G. Male genitalia, H. Body of spermatheca, I. Spermathecae, J. Female wing, K. Male wing, L. Female cibarium.

Male: Rio Anori, Antioquia Dept., Colombia

Female: Panama Canal Zone

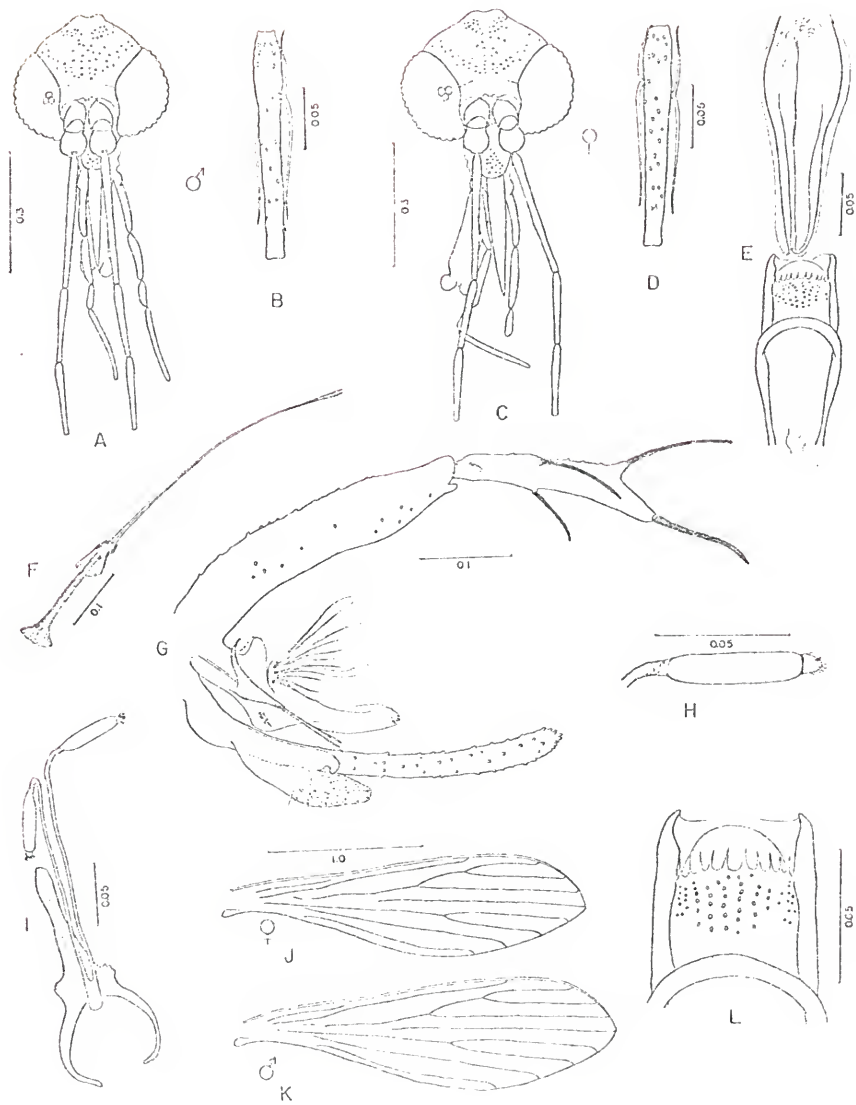


Figure 39

*Lutzomyia dendrophyla* -- A. Male genitalia, B. Spermathecae,  
C. Female cibarium.

Male: Leticia, Amazonas Comisaria, Colombia

Female: Same locality as male



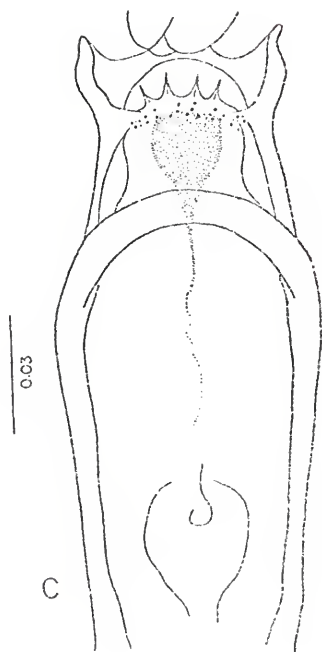
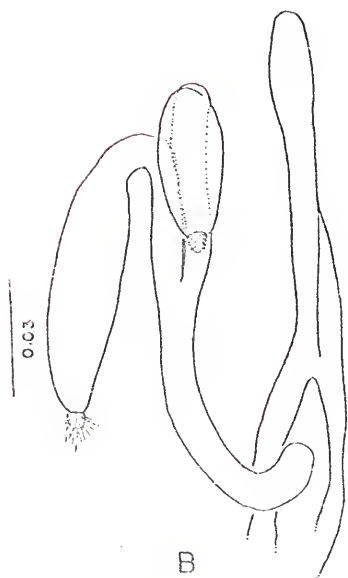
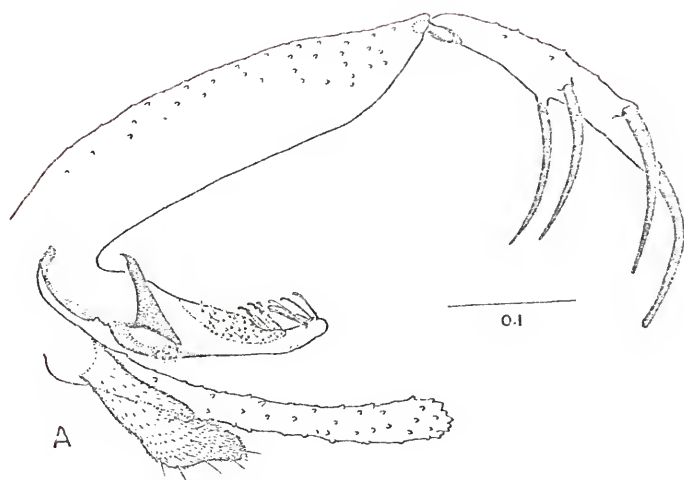


Figure 40

*Lutzomyia punctigeniculata* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Paramere, G. Male genitalia, H. Body of spermatheca, I. Spermathecae, J. Female wing, K. Male wing, L. Female cibarium.

Male: Curiche, Choco Dept., Colombia

Female: Panama Canal Zone

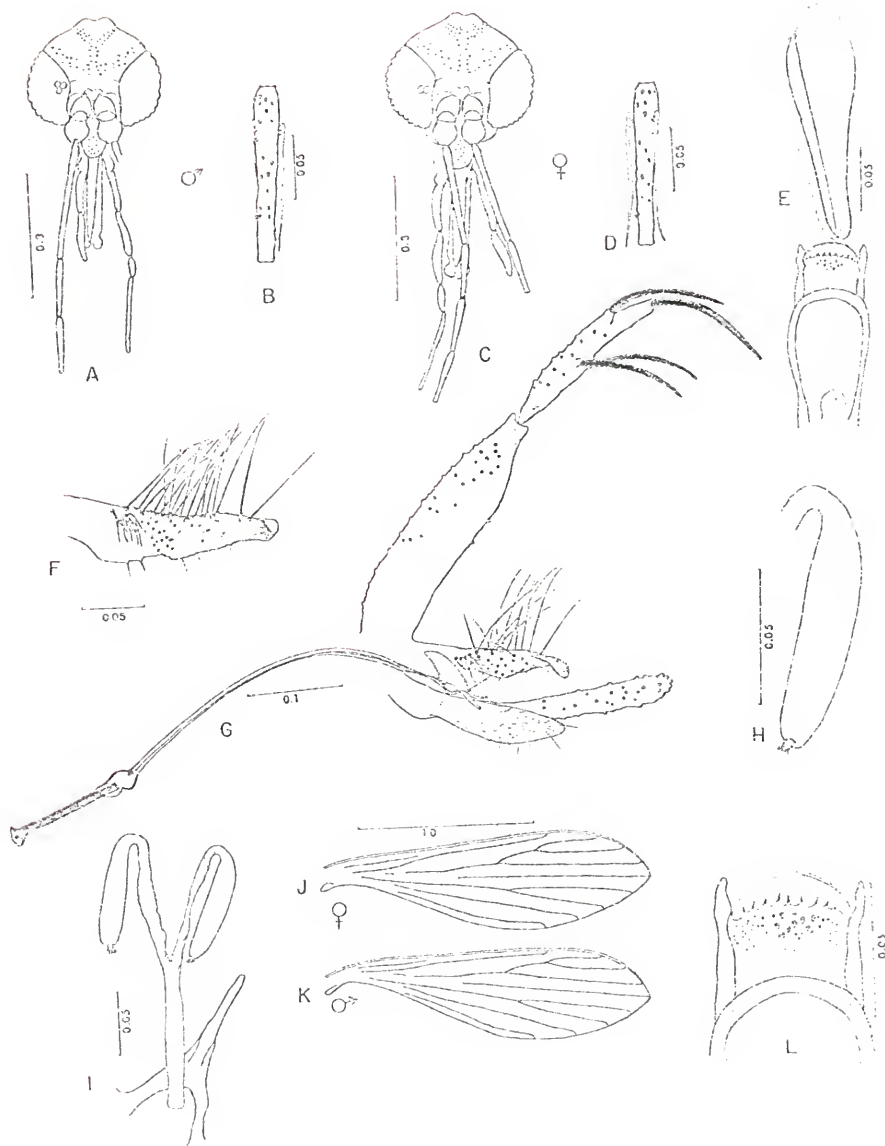


Figure 41

*Lutzomyia shannoni* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Spermathecae, G. Male genitalia, H. Body of spermatheca before maceration in NaOH, Alachua Co., Florida, U.S.A., I. Female wing, J. Male wing, K. Female cibarium.

Male: Teresita, Choco Dept., Colombia

Female: Same locality as male (except Fig. 41H)

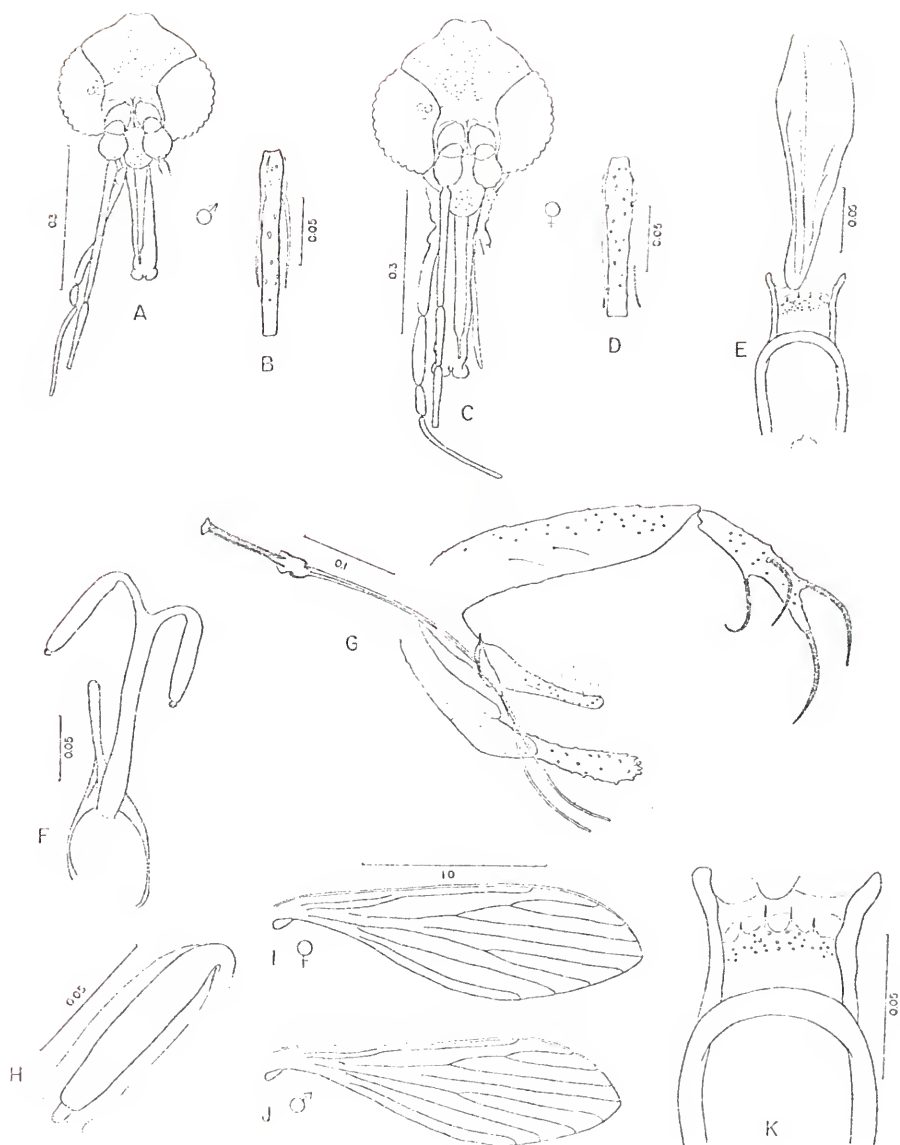
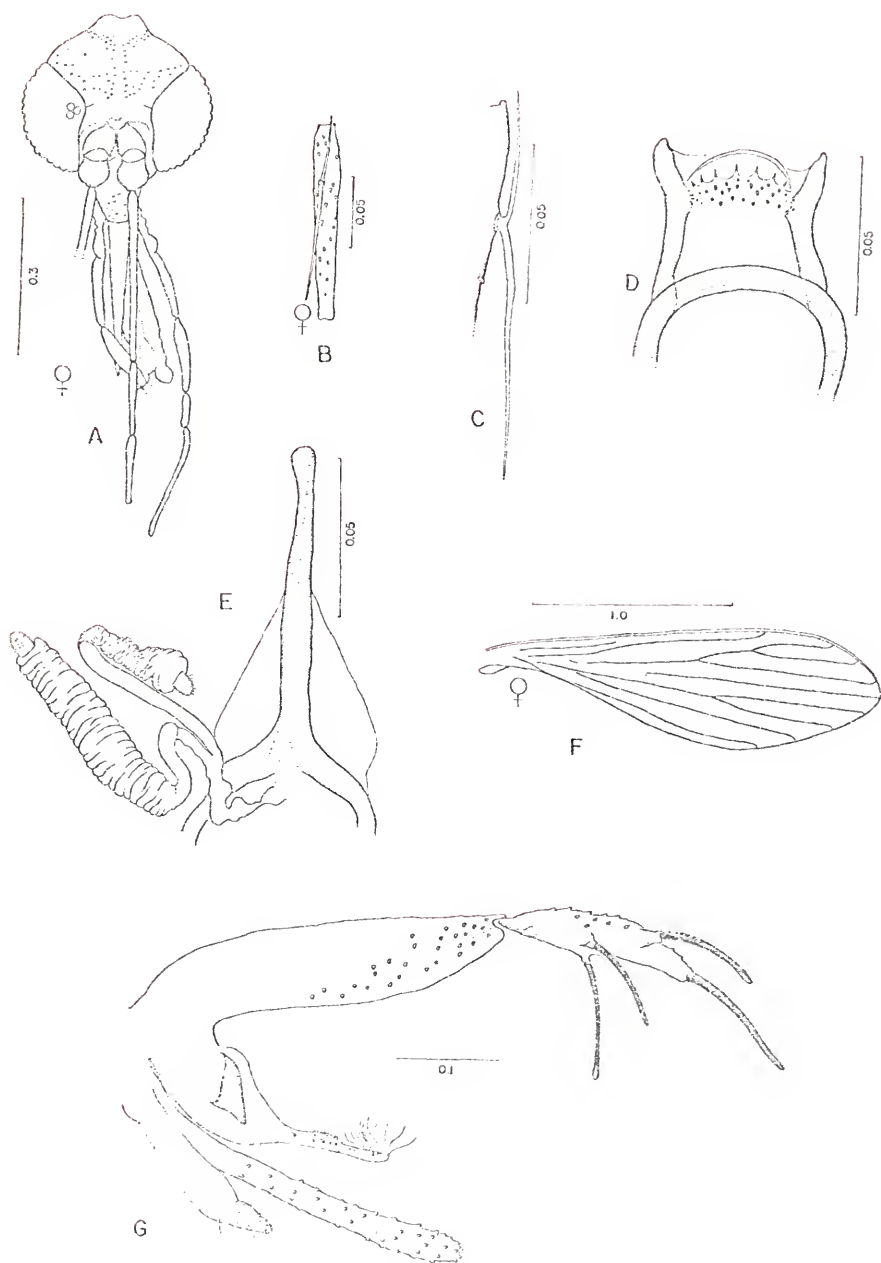


Figure 42

*Lutzomyia undulata* -- A. Female head, B. Female flagellomere II, C. Ascoid on female flagellomere III, D. Female cibarium, E. Spermathecae, F. Female wing.

Male: Chiapas State, Mexico

Female: Curiche, Choco Dept., Colombia



Longispina Group Theodor, 1965

This group corresponds to the subgenus *Trichopygomyia* Barretto, 1962, later enlarged by Forattini (1971a, 1973) to accomodate 30+ additional species.

Seven of the 8 *longispina* group species occur in or near the Amazon Basin. *Lutzomyia triramula*, a trans-Andean species, ranges as far north as Belize and is especially common in lowland forests in Panama and northwestern Colombia. Most species seem to be readily attracted to light, often inhabit mammal burrows but do not attack humans.

Two *longispina* group species, apparently allopatric, have been reported in Colombia (Osorio et al., 1972a).

Keys to Species

Males

1. Parameres as shown, trifurcate . . . . . *triramula* (Fig. 44)

Parameres otherwise, bifurcate . . . . . *longispina* (Fig. 43)

Females

1. Length of common sperm duct less than 2 x width of spermatheca.

Cerci broad apically . . . . . *longispina* (Fig. 43)

Length of common sperm duct greater than 2 x width of spermatheca.

Cerci slender or constricted apically. . . . . *triramula* (Fig. 44)



52. *Lutzomyia longispina*  
(Fig. 43)

*Phlebotomus longispinus* Mangabeira, 1942a: 186 (♂ holotype, Aura, Belem, Para, Brazil). Mangabeira, 1942d: 251 (immatures descr.). Barretto, 1947: 209 (catalog). Causey & Damasceno, 1948: 628 et seq. (cf. to *wagleyi*, ♂ fig.). Damasceno et al., 1949: 827 (Brazil). Vargas & Diaz-Nájera, 1951a: 22 (cf. to *pratti*). Pifano & Ortiz, 1952: 142 (Bolívar, Venezuela). Floch & Abonnenc, 1952: 33, 48 (♂, ♀ keyed). Fairchild & Hertig, 1952: 518 (cf. to *triramulus*). Pifano et al., 1962: 385, 389 (♂, ♀ keyed). Sherlock & Pessoa, 1964: 333 (Bahia, Brazil). Hanson, 1968: 88 (larva, cf. to *triramulus*).

*Lutzomyia longispina*: Barretto, 1962: 98 (listed). Theodor, 1965: 189 (♂, figs.). Martins et al., 1965: 14 (cf. to *rondoniense*). Osorno et al., 1972a: 57 (Caqueta, Colombia). Forattini, 1973: 172 et seq. (gen. review, figs.). Lewis, 1975a: 502 et seq. (mouthpart morphol.). Ramirez et al., 1976: 602 (mention). Martins et al., 1976a: 491 (cf. to *elegans*).

*Distribution*: Brazil, Venezuela, Colombia (Caqueta).

*Material examined*: Colombia. 1 ♀ (INPES no. 7068), San Miguel, Municip. Florencia (Caqueta), tree hole, 20 June 1971, E. Osorno & A. Morales. Brazil. 1 ♂, Cacheira (Bahia), armadillo burrow, 7 July 1959, Afonso. 1 ♂, Aura, Belem (Para), burrow, June 1941, R. Damasceno. 1 ♂, Ilha Preta, Belem (Para), 6 Nov. 1959, J. Silva.

*Discussion*: A single female from Colombia, though treated under this name, may or may not be conspecific with *longispina*, confirmation being possible only when the male is discovered. The Colombian female generally agrees with the description given by Mangabeira (1942d). The

individual sperm ducts are wrinkled in part, unlike those of *L. triramula*, but this could be a result of mounting technique and not a reflection of normal structure. The spermathecae (Fig. 43A) are larger than those of *triramula* and the cerci are broader apically (Fig. 43C).

53. *Lutzomyia triramula*  
(Fig. 44)

*Phlebotomus triramulus* Fairchild & Hertig, 1952: 517 (♂ holotype, ♀, Rio del Medio, near Rio Gatun, Colon. Prov., Panama). Johnson & Hertig, 1961: 765, 775 (rearing data, biting man in laboratory). Hanson, 1968: 86 (larva, pupa, descr.). Sherlock, 1962: 321 (Santander, Colombia). Barreto, 1969: 467 (Valle, Colombia).

*Lutzomyia triramula*: Barretto, 1962: 98 (listed). Martins et al., 1965: 14 (cf. to *rondoniensis*). Williams, 1970: 333 et seq. (summary of collecting data, Belize). Chaniotis et al., 1971a: 344 (pop. dynamics, Panama). Chaniotis et al., 1972: 95 (in burrows). Osorno et al., 1972a: 57 (Colombian records). Christensen, 1972a: 88 (listed). Forattini, 1973: 123 et seq. (gen. review, figs.). Chaniotis & Correa, 1974: 115 (in light traps). Lewis, 1975a: 503 et seq. (mouthpart morphol.). Rutledge et al., 1975: 180 (in light traps). Martins et al., 1976a: 491 (cf. to *elegans*). Herrero & Christensen, 1976a: 62 (collecting data, Panama). Ramirez et al., 1976: 602 (mention).

*Distribution*: Belize, Panama, Colombia (Antioquia, Choco, Santander, Valle).

*Material examined*: Colombia. 78 ♂♂, 40 ♀♀, Rio Anori (Antioquia), light & flight traps, April-June 1970, C.H.P. 30 ♂♂, 54 ♀♀, same locality light traps, Sept. 1970, D.G.Y. 111 ♂♂, 277 ♀♀, Curiche (Choco), light,

Malaise, & Shannon traps, April-Nov. 1967, D.G.Y. 4 ♂♂, 19 ♀♀, Alto Curiche (Choco), July-Nov., 1967, D.G.Y. 1 ♂, Teresita (Choco), tree trunk, 23 June 1967, D.G.Y. 1 ♂, same locality, light trap, 8 Oct. 1967, D.G.Y. 1 ♂, 2 ♀♀, 25 km E of Buenaventura (Valle), tree trunks, 11 Aug. 1973, D.G.Y. & R.C.W. 5 ♂♂, 13 ♀♀, same locality, light & flight traps, 12 Aug. 1973, D.G.Y. & R.C.W. *Panama*. 1 ♂ (holotype no. 1754), type locality, tree buttress, 14 Oct. 1949, R. Hartmann. 1 ♀ (allotype no. 2376), La Victoria, Cerro Jefe (Panama Prov.), Shannon trap, 20 Aug. 1950, M. Hertig & P. Galindo. Numerous other specimens, most of which were listed by Fairchild & Hertig (1952).

*Discussion:* Females of *triramula* from a population E of Buenaventura vary from those in Antioquia and Choco Depts., Colombia, and Panama in the shape of the cerci. They are relatively slender (Fig. 44C); more so than those of *longispina* (Fig. 43C) and lack the nipple-like end which is characteristic of females from the more northern localities. The males from near Buenaventura are generally similar to those from other localities but the main lobe of the paramere is more recurved and slender apically. I attribute these differences to geographic variation and for the present, at least, regard them all as conspecific.

Figure 43

*Lutzomyia longispina* -- A. Spermathecae, B. Female cibarium, C. Female cercus, D. Male genitalia.

Male: Bahia State, Brazil

Female: Florencia, Caqueta Intendencia, Colombia

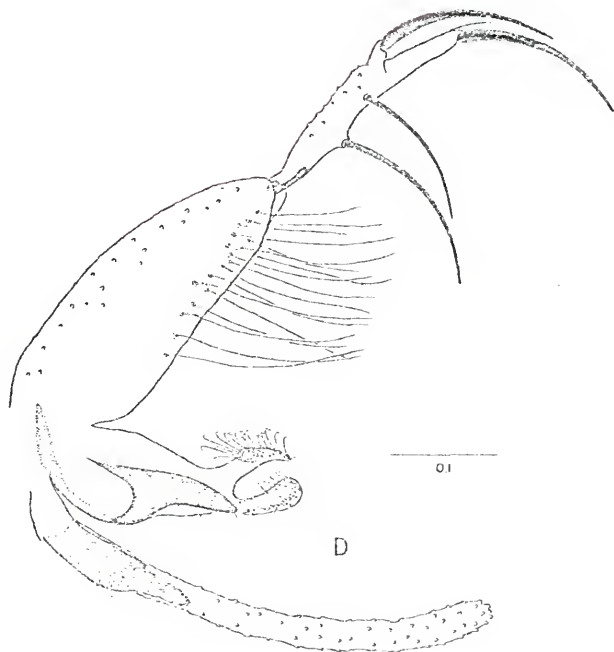
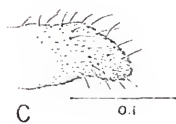
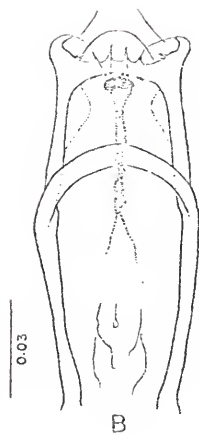
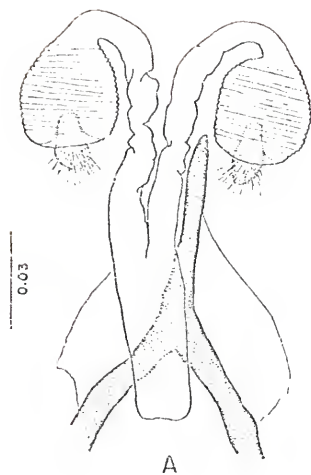
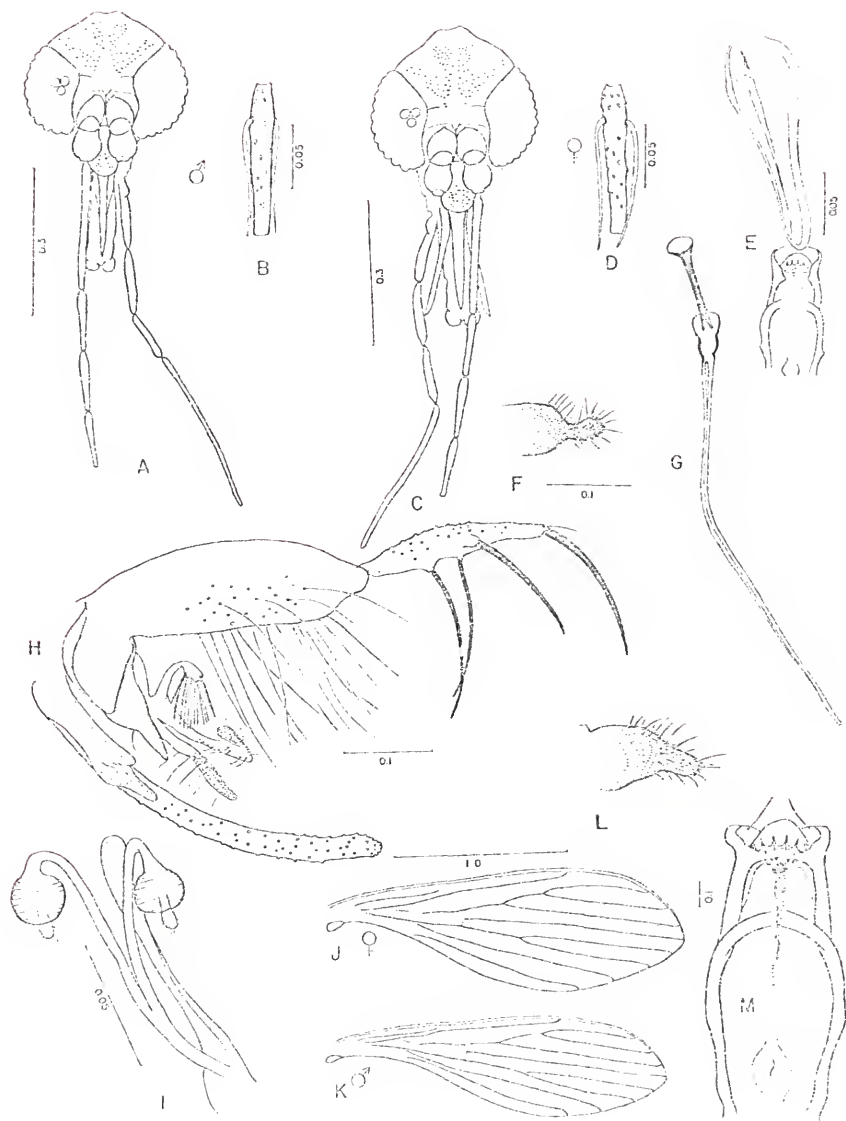


Figure 44

*Intromyia triramula* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Female cercus, G. Genital pump and filaments, same scale as Fig. 44H, H. Male genitalia, I. Spermathecae, J. Female wing, K. Male wing, L. Female cercus, specimen from Valle Dept., Colombia, M. Female cibarium.

Male: Curiche, Choco Dept., Colombia

Female: Same locality as male (except Fig. 44L)



Aragaoi Group Theodor, 1965

Theodor (1965) divides these species into 2 categories, the series *aragaoi* (7 spp.) and series *brasiliensis* (4 spp.), based upon the spermathecae which are sac-like in the series *aragaoi* females, tubular in those of the *brasiliensis* series. Fairchild (1955), Barretto (1962), Ortiz (1972a), and others combine the *aragaoi* group species with those in the *shannoni* group on the basis of several characteristics, the latter two authors placing them in the subgenus *Psathyromyia* Barretto, 1962.

The status of *L. pifanoi* (Ortiz), a Venezuelan species is not yet clear. It certainly belongs in the *aragaoi* group but is known from a single male which somewhat resembles *L. runoides*. *Eutzomyia abunaensis* Martins, Falcao and da Silva (1965), from Brazil and Ecuador, also described from the male, is similar to that of *L. brasiliensis* (Costa Lima, 1932). I examined a male and several females of *abunaensis*, to be described in another paper, from Limoncocha, Napo Prov., Ecuador. The females differ from those of *brasiliensis* in having 8+ horizontal cibarial teeth instead of 4 and by the shorter sperm ducts. The spermathecae of both females are similar in shape and size. The presence of one or both of these species in Colombia would not be surprising.

Keys to Species

Males

1. Genital filament tips hooked or twisted. . . . . 2
- Genital filament tips simple, pointed, or spear shaped . . . . . 3



2. Style with isolated basal spine. Genital filament tips shaped like a button hook. Aedeagus more slender. Paramere as shown . . . . .  
. . . . . *carpenteri* (Fig. 48)  
  
Style with paired or nearly paired basal spines. Genital filament tips twisted like a corkscrew. Paramere variable but never as above . . . . . *aragaoi* (Fig. 45)
3. Genital filament tips markedly inflated, spear-shaped. Coxite without scattered setae on inner surface. . . . . *runoides* (Fig. 49)  
  
Genital filament tips simple, not inflated. Coxite with scattered setae on inner surface. . . . . 4
4. Lateral lobes greater than 0.56 mm. Parameres as shown, the ventral "heel" better developed . . . . . *barrettoii majuscula* (Fig. 46)  
  
Lateral lobes less than 0.50 mm. Parameres otherwise, more slender, lacking a ventral heel. . . . . *barrettoii barrettoii* (Fig. 47)

#### Females

1. Spermathecae tubular with convoluted individual ducts . . . . .  
. . . . . *runoides* (Fig. 49)  
  
Spermathecae sac-like, much wider than nonconvoluted ducts. . . . . 2
2. Spermathecae pear shaped with an expanded neck, individual ducts with fine transverse striations. . . . . *carpenteri* (Fig. 48)  
  
Spermathecae otherwise, ovoid or spherical, individual ducts smooth walled. . . . . 3

3. Spermathecae smaller, subspherical with apical "hairs" not arising from a differentiated area. . . . . *aragaoi* (Fig. 45)
- Spermathecae larger, ovoid with apical "hairs" arising from a raised circular area . . . . . 4
4. Spermathecae larger, their ducts expanded where they enter spermathecae. . . . . *barrettoi barrettoi* (Fig. 47)
- Spermathecae smaller, their ducts more slender, subequal in width throughout. . . . . *barrettoi majuscula* (Fig. 46, 47)

Series *aragaoi*

54. *Lutzomyia aragaoi*  
(Fig. 45)

*Phlebotomus aragaoi* Costa Lima, 1932: 48 (♂ Lassance, Minas Gerais, Brazil). Barretto, 1947: 185-186 (full refs.). Floch & Abonnenc, 1952: 131-134 (in part, ♂ only). Fairchild & Hertig, 1953a: 21 et seq. (♂, ♀, redescr., figs., keyed, refs., Panama). Vargas & Diaz-Najera, 1959: 146 (cf. to *humboldti*). Fairchild & Hertig, 1961b: 250 (♀ cf. to *botella*). Lucena & Almeida, 1964: 187 et seq. (♂, ♀ redescr., figs.). Sherlock & Pessoa, 1964: 333 (resting sites, Brazil). Lucena, 1967: 271 (mention). Ortiz, 1972a: 23-25 (listed, cf. to *pifanoi*).

*Phlebotomus heckenrothi* Floch & Abonnenc, 1942b: 8 (♀, French Guiana). Barretto, 1946c: 430 (listed). Floch & Abonnenc, 1952: 47, 176 (♀ keyed, redescr., figs.). Fairchild & Hertig, 1953a: 21 et seq. (♀ keyed, cf. to *aragaoi*, refs.). Ortiz, 1972a: 23 (listed). Pifano et al., 1973: 158 (listed). Forattini, 1973: 456 (as synonym of *aragaoi*).

*Lutzomyia aragaoi*: Barretto, 1962: 99 (listed). Theodor, 1965: 186 (♂, ♀, figs). Martins et al., 1965: 2 (Rondonia, Brazil). Barreto, 1969: 462-463 (Valle, Colombia). Lewis et al., 1970: 215 (parous rates). Chaniotis et al., 1971a: 344 et seq. (collecting data, Panama). Christensen, 1972a: 88 (listed). Osorno et al., 1972a: 37 (Vichada, Colombia). Chaniotis et al., 1972: 95 (resting sites). Lewis, 1975a: 501 (mouthpart morphol., cibarium fig.). Martins et al., 1976a: 488 (Peru).

*Lutzomyia heckerrothi*: Barretto, 1962: 99 (listed). Martins & Morales, 1972: 367 (listed).

*Psychodopygus aragaoi*: Forattini, 1971a: 105 (listed). Forattini, 1973: 416 et seq. (gen. review, figs.).

*Distribution*: Panama, Colombia (Amazonas, Antioquia, Choco, Valle, Vichada), Peru, Brazil, Paraguay, French Guiana, Trinidad.

*Material examined*: Colombia. 1 ♂, 17 km W of Leticia (Amazonas), light trap, 26 July 1973, D.G.Y. & R.C.W. 2 ♂♂, 1 ♀, Rio Anorí (Antioquia), 2-5 May 1970, C.H.P. 7 ♀♀, same data but 20-22 Sept. 1970, D.G.Y. 1 ♂, same data but 14 April 1971, C.H.P. 1 ♂, Tres Esquinas (Caqueta), light trap, 10 Nov. 1971, C.J.M. 52 ♂♂, 70 ♀♀, Curiche (Choco), light & Malaise traps, April-Nov. 1967, D.G.Y. 2 ♀♀, Alto Curiche (Choco), light trap, 2 July 1967, D.G.Y. 2 ♂♂, 2 ♀♀, Anchicaya Dam (Valle), light traps, 10-11 Aug. 1973, D.G.Y. & R.C.W. 1 ♀, 25 km E of Buenaventura (Valle), light trap, 12 Aug. 1973, D.G.Y. & R.C.W. Brazil, French Guiana, Panama, and Paraguay. Those specimens listed by Fairchild & Hertig (1953a). Trinidad. 50+ ♂♂, 50+ ♀♀, from various localities to be treated in a forthcoming paper.

*Discussion:* According to locality, the males of *L. aragaoi* vary in the shape of the parameres. Those seen by me or figured by others from Brazil (Costa Lima, 1932), Colombia (Rio Anorí, near Leticia, and Anchicaya Dam), Panama (Fairchild & Hertig, 1953a), and Peru (Lucena & Almeida, 1964) have relatively slender parameres compared to those from French Guiana (Floch & Abonnenc, 1952), Trinidad, and Colombia (Choco Dept. and Tres Esquinas in Caqueta Dept.). Whether clinal or not, I believe that this variation is intraspecific, the other character states of both sexes being remarkably similar.

Like Forattini (1973), I consider *L. heckenrothi* (Floch & Abonnenc, to be the female of *L. aragaoi*. Floch & Abonnenc's subsequent figure (1945c) shows long sperm ducts with warty protuberances, as noted by Fairchild & Hertig (1953a), but this probably represents an abnormal specimen, a poor slide mount or, less likely, another species.

55. *Lutzomyia barrettoi barrettoi* New Status  
(Fig. 47)

*Phlebotomus barrettoi* Mangabeira, 1942a: 148 (♂ holotype, Belem, Aura, Para, Brazil). Barretto, 1947: 189 (refs.). Floch & Abonnenc, 1952: 38 (♂ keyed), 144 (♂ redescri., figs.). Fairchild & Hertig, 1953a: 26 (refs.). Fairchild & Hertig, 1959: 121 (in part, Brazil & French Guiana). Vargas & Diaz-Nájera, 1959: 146 (cf. to *humboldti*). Sherlock & Carneiro, 1964: 206, 208 (internal morphol., ♂, fig.). Rosabal, 1966: 1-2 (in part, distrib.). Ortiz, 1972a: 23-24 (listed).

*Phlebotomus* sp. de Maripa Floch & Abonnenc, 1946: 3 (♀, French Guiana). Floch & Abonnenc, 1952: 46, 191 (♀ keyed, redescri., figs.).

*Lutzomyia barrettoi*: Barretto, 1962: 99 (listed). Martins et al., 1976: 488 (Peru).

*Psychodopygus barrettoi*: Forattini, 1971a: 105 (listed). Forattini, 1973: 416 et seq. (in part).

*Distribution*: Colombia (Caqueta), Peru, Brazil, French Guiana, Trinidad.

*Material examined*: Colombia. 2 ♂♂, 2 ♀♀, Tres Esquinas (Caqueta), light trap, 10-11 Nov. 1971, C.J.M. Brazil. 1 ♂, O. Mangabeira, no. 1075, no other data. Trinidad. 1 ♀, Macqueripe U.S. Naval Station, light trap, 19 Nov. 1956, T.H.G. Aitken. 1 ♂, Tucker Valley U.S. Naval Station, light trap, 14 Nov. 1957, T.H.G. Aitken. 1 ♂, San Jose Point U.S. Naval Station, light trap, 18 Nov. 1957, T.H.G. Aitken.

*Discussion*: Specimens of *L. barrettoi* from east of the Andes in Colombia (Caqueta), Brazil, French Guiana, Trinidad, and probably Peru agree closely with the descriptions of Mangabeira (1942a) and Floch & Abonnenc (1946, 1952, as sp. de Maripa). I am convinced that *Lutzomyia* sp. de Maripa is the female of *L. b. barrettoi* based upon morphology and collecting data in Trinidad and Caqueta Dept., Colombia. The spermathecae are large and oval, their ducts subequal in width throughout (Fig. 47B). Other features of diagnostic importance are discussed under *L. barrettoi majuscula* n. ssp.

56. *Lutzomyia barrettoi majuscula* n. ssp.  
(Fig. 46, 47)

*Phlebotomus barrettoi*: Fairchild & Hertig, 1953a: 21 et seq. (♂, ♀, descr., keyed, figs.). Rodriguez, 1956: 79 (Ecuador). Fairchild & Hertig, 1959: 121 et seq. (in part, Central American records). Fairchild

& Hertig, 1961b: 250 (cf. to *botella*). Johnson & Hertig, 1961: 765 (rearing data). Rosabal & Trejos, 1964: 167 (El Salvador). Rosabal, 1966: 1-2 (Costa Rica). Hanson, 1968: 51 (first instar larva, descr., fig.).

*Eklebotomus* sp. no. 6 Rosabal, 1954: 6, 46 (Costa Rica).

*Lutzomyia barretto*: Barreto, 1969: 463 (Valle, Colombia). Chaniotis et al., 1971a: 344 et seq. (collecting data, Panama). Christensen, 1972a: 88 (listed). Christensen et al., 1972: 57 (in animal burrow, Panama). Chaniotis et al., 1972: 95 (resting sites). Osorno et al., 1972a: 38 (mention).

*Psychodopygus barretto* Forattini, 1973: 416 et seq. (in part).

*Distribution* El Salvador, Nicaragua, Costa Rica, Panama, Colombia (Antioquia, Choco, Valle), Ecuador.

*Material examined:* Panama. 1 ♂ (holotype no. 6320), Cruces Trail, Madden Forest Reserve, Canal Zone, animal burrow, 6 Jan. 1957, M. Hertig. 1 ♀ (allotype no. 4732), Camp Pina, Canal Zone, light trap, 24 May 1954, F. Blanton. 1 ♂ (paratype no. 4200), San Lorenzo, Canal Zone, light trap, 15 Aug. 1952, F. Blanton. 1 ♀ (paratype no. 3914), Mojinga Swamp, Canal Zone, light trap, 31 Jan. 1952, F. Blanton. 1 ♀ (paratype no. 4735), Canal Zone, light trap, 29 June 1954, G. Field. 3 ♂♂, 4 ♀♀ (paratypes nos. 270-276), Cerro Azul (Panama), Burrow, 24 March 1968, D.G.Y.

Colombia. 1 ♀ (paratype no. 277), Rio Anorí (Antioquia), light trap, 22 Sept. 1970, D.G.Y. 1 ♂ (paratype no. 278) Alto Curiche (Choco), light trap, 7 July 1967, D.G.Y. 1 ♀ (paratype no. 279), Curiche (Choco), Malaise trap, 29 June 1967, D.G.Y. Costa Rica. 1 ♂ (paratype no. 3447), Suerre de Guapiles, tree buttress, 29 April 1951, R. Rosabal. Ecuador. 1 ♂ (paratype no. 280), 17 km E of Santo Domingo de Los Colorados

(Pichincha), light trap, 27 May 1976, D.G.Y., T. Rogers, & C. Fairchild. 1 ♀ (paratype no. 281), same data but May 1976. *Nicaragua*. 1 ♂ (paratype no. 4457), Guapilonar, Carrazo, light trap, 21 Oct. 1953, A. Adames. Other material examined: *Colombia*. 1 ♂, 5 ♀♀, Curiche (Choco), light & Malaise traps, 5 July-28 Aug. 1967, D.G.Y. 1 ♀, 25 km E of Buenaventura (Valle), light trap, 12 Aug. 1973, D.G.Y. & R.C.W.

*Discussion:*

*Male:* As described and illustrated by Fairchild & Hertig (1953a, as *L. barrettoii*) with the following additions based upon the holotype of *L. b. majuscula* n. ssp. Wing length 2.47; width 0.78. Head height 0.38; width 0.44. Eyes separated by 0.10 or by distance = to 4.6 facet diameters. Flagellomere I (0.30 long); combined length of flagellomeres II + III = 0.38. Length of palpal segments: 1 (0.03), 2 (0.08), 3 (0.12), 4 (0.07), 5 (0.16). Labrum 0.20 long. Cibarial arch nearly complete; pigment patch distinct, subtriangular. Pharynx 0.20 long. Pleura with 13 upper and 4-5 lower episternal setae. Length of wing vein sections: *Alpha* (0.80), *beta* (0.22), *delta* (0.42), *gamma* (0.19). Length of femora, tibiae, and basitarsi: Foreleg, 1.06, 1.56, 0.95; midleg, 0.98, 1.66, 0.98. Hindleg missing. Genitalia: Length of style 0.28; coxite 0.49; lateral lobe 0.60; genital pump 0.21, filaments 0.78 (the latter 3.7X length of pump).

*Female:* As described and illustrated by Fairchild & Hertig (1953) with the following additions based upon the allotype of *L. b. majuscula* n. ssp. Wing length 2.60; width 0.88. Head height 0.42; width 0.46. Eyes separated by 0.45 or by distance = to 5 facet diameters. Flagellomere I 0.29 long); combined length of flagellomeres II + III = 0.37. Length of palpal segments: 1 (0.03), 2 (0.09), 3 (0.14), 4 (0.07), 5

(0.17). Cibarium with 15 horizontal teeth, about 20 vertical teeth in 2-3 transverse rows, the 7 closest to horizontal teeth markedly enlarged; cibarial arch nearly complete, pigment patch prominent as shown by Fairchild & Hertig (1953a, fig. 21). Labrum 0.19 long. Pharynx 0.20 long. Pleura with 15-16 upper and 4-5 lower episternal setae. Length of wing vein sections: *Alpha* (0.88), *beta* (0.22), *delta* (0.51), *gamma* (0.19). Legs missing. Spermathecae and ducts as figured.

Although larger than *L. b. barrettoi*, the female of *L. b. majuscula* has smaller spermathecae and the ducts are noticeably swollen where they enter the spermathecae (Fig. 47A). The tip of the genital fork stem, shallowly bifid in *majuscula*, is variable in *b. barrettoi* (Fig. 47C-E). Without females or locality data, the males are difficult to distinguish but the parameres of *majuscula* are slightly broader with a better developed ventral "heel." The lateral lobes of this taxon range between 0.57-0.61 mm in length; those of *b. barrettoi* are shorter, not exceeding 0.50 mm. The wing length of *majuscula* ♂♂ ranges from 2.3 to 2.7 mm; ♀♀ from 2.5 to 2.8 mm. The wing length of *b. barrettoi* ♂♂ ranges from 1.8 to 2.2; ♀♀ from 2.1 to 2.4. The subspecific name refers to the larger size of the *majuscula* specimens.

This subspecies like *L. carrerai thula* n. ssp., occurs west of the Andes in Ecuador and Colombia, then northward into Central America to El Salvador.

Sherlock & Carneiro (1964) suggest that *L. texana* (Dampf) from Texas (U.S.A.), Mexico, and Honduras (unpub. data) and *L. barrettoi* may be conspecific, basing their interpretation on the description of *texana* by Dampf (1938). While examining numerous specimens of the former species (Young, 1972b), I noted that the males of the two species can not



be separated by the key given by Fairchild & Hertig (1953a), the styles of both species with the isolated spine set upon a well marked tubercle closer to the basal spines than to the terminal spine. They differ, however, in the relative lengths of the genital filaments (less than  $2.6 \times$  length of the pump for *texana*;  $2.8 \times$  or greater for the *barrettoi* subspecies). The scattered hairs on the inner surface of the coxites are long in *texana* but rather short in *barrettoi*. The females are more easily distinguished, as was done by Fairchild & Hertig (op. cit., in key) and by the nearly spherical, smaller spermathecae of *texana* (Fig. 47I).

57. *Lutzomyia carpenteri*  
(Fig. 48)

*Phlebotomus carpenteri* Fairchild & Hertig, 1953a: 28 ( $\sigma^7$  holotype, Chiva Chiva, Canal Zone;  $\phi$ , near Pacora, Panama Prov., Panama). Fairchild & Hertig, 1959: 121-122 (Central American records). Fairchild & Hertig, 1961b: 250 (cf. to *botella*). Johnson & Hertig, 1961: 765, 773 (rearing data). Biagi et al., 1966: 141 et seq. ( $\sigma^7$ ,  $\phi$ , figs., Mexico). Hanson, 1968: 53 (first instar larva, descr., fig.). Ortiz, 1972a: 23-24 (listed).

*Lutzomyia carpenteri*: Barretto, 1962: 99 (listed). Williams, 1970: 332 et seq. (summary of collecting data, Belize). Tesh et al., 1971a: 153 (blood meal from bird). Chaniotis et al., 1971a: 344 et seq. (collecting data, Panama). Christensen, 1972a: 88 (listed). Chaniotis et al., 1972: 95 et seq. (resting sites). Shaw & Lainson, 1972: 709 (mention). Christensen et al., 1972: 57 et seq. (collecting data, negative for flagellates, Panama). Christensen & Herrero, 1973: 579 et seq. (collecting data, negative for trypanosomatids). Chaniotis & Correa,

1974: 115 (light trap data). Lewis, 1975a: 501 et seq. (mouthpart morphol.). Rutledge & Ellenwood, 1975a: 73 (breeding site, open forest floor, Panama). Rutledge et al., 1975: 179 et seq. (light trap data). Williams, 1976a: 604 (in caves, Belize).

*Psychodopygus carpenteri*: Forattini, 1971a: 105 (listed). Forattini, 1973: 390 et seq. (gen. review, figs.).

*Distribution*: Mexico, Belize, Costa Rica, Panama, Colombia (Antioquia, Choco).

*Material examined*: Colombia. 72 ♂♂, 10 ♀♀, Rio Anori (Antioquia), light traps, May 1970, C.H.P. 12 ♂♂, 25 ♀♀, same data but Sept. 1970, D.G.Y. 29 ♂♂, 33 ♀♀, Curiche (Choco), light, Shannon, & Malaise traps, April-Dec. 1967, D.G.Y. 1 ♀, Teresita (Choco), Malaise trap, 22 April 1967, D.G.Y. 1 ♂, same data but light trap, 29 Sept. 1967. 1 ♀, same data but 28 Oct. 1967. Panama. 1 ♂ (holotype no. 1345), Chiva Chiva, Canal Zone, light trap, Oct. 1948, S. Carpenter. 1 ♀ (allotype no. 2301), near Pacora (Panama Prov.), burrow, 13 Aug. 1950, M. Hertig. 9 ♂♂, 8 ♀♀, Canal Zone, various dates and localities.

*Discussion*: *L. carpenteri*, previously unknown in Colombia, is a nonanthrophilic species which, like other members of the *aragaoi* group, is readily attracted to light and is often discovered in animal burrows.

Both sexes are readily identified by the characters given in the key.

Series *brasiliensis*

58. *Lutzomyia runoides*  
(Fig. 49)

*Phlebotomus runoides* Fairchild & Hertig, 1953a: 30 (♂ holotype, Almirante, Bocas del Toro Prov., Panama; ♀, La Victoria, Cerro Jefe, Panama Prov., Panama). Fairchild & Hertig, 1959: 122 (Central American records). Vargas & Diaz-Nájera, 1959: 146 (cf. to *humboldti*). Johnson & Hertig, 1961: 765 et seq. (rearing data). Mangabeira & Sherlock, 1962: 318 (cf. to *brasiliensis*). Thatcher & Hertig, 1966: 52 (in mammal burrows). Hanson, 1968: 71-71 (fourth instar larva, descr., figs.). Ortiz, 1972a: 23-24 (listed).

*Lutzomyia runoides*: Barretto, 1962: 99 (listed). Martins et al., 1965: 3, 7, 19 (Rondonia, Brazil, cf. to *abuncensis*). Barreto, 1969: 466 (Valle, Colombia). Chaniotis et al., 1971a: 344 et seq. (collecting data, Panama). Christensen, 1972a: 88 (listed). Osorno et al., 1972a: 38 (Caqueta, Colombia). Chaniotis et al., 1972: 95 (resting sites). Christensen & Herrero, 1973: 579 (collecting data, Panama).

*Psychodopygus runoides*: Forattini, 1971a: 105 (listed). Forattini, 1973: 469 (as synonym of *inflata*).

*Distribution*: Costa Rica, Panama, Colombia (Amazonas, Antioquia, Caqueta, Valle), Brazil.

*Material examined*: Colombia. 2 ♀♀, 17 km W of Leticia (Amazonas), flight trap, 26 July 1973, D.G.Y. & R.C.W. 16 ♂♂, Rio Anorí (Antioquia), light traps, May 1970, C.H.P. 7 ♂♂, 2 ♀♀, same data but Sept. 1970, D.G.Y. Panama. 1 ♂ (holotype no. 3593), type locality, tree buttress, 25-27 July 1951, A. Quinones. 20 ♂♂, 13 ♀♀ from various localities in

the Canal Zone (Mojinga Swamp, Barro Colorado Island, Juan Mina), and in the Republic of Panama (Almirante, Cerro Jefe, Cerro Campana).

*Discussion:* This species and *L. inflata* (Floch & Abonnenc) from French Guiana are very close and may indeed be conspecific as Forattini (1973) proposes. Without material from French Guiana, however, and in view of the distinguishing characteristics outlined by Fairchild & Hertig (1953a), I prefer to treat them as distinct taxa, realizing that the status of *L. runoides* may have to be reconsidered in the future.

Figure 45

*Eutzomyia aragaoi* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Spermathecae, G. Male genitalia, H. Body of spermatheca, I. Female wing, J. Male wing, K. Female cibarium.

Male: Curiche, Choco Dept., Colombia

Female: Same locality as male

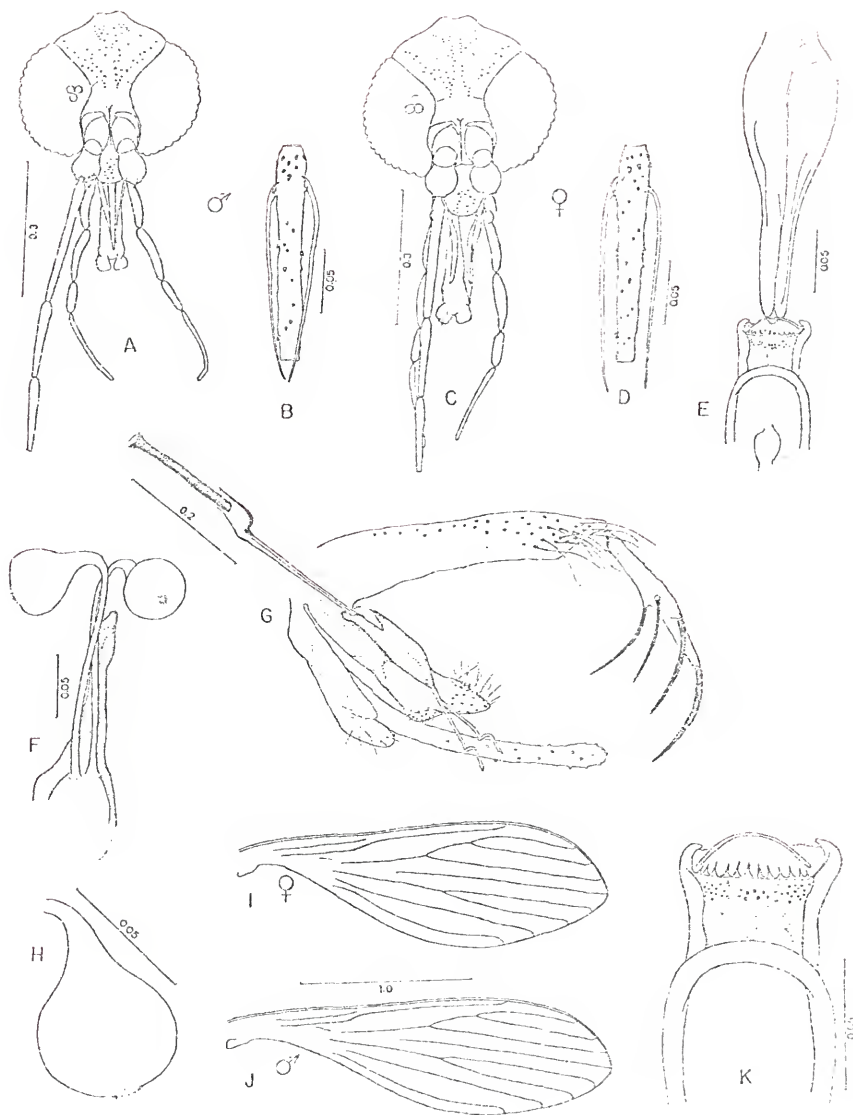


Figure 46

*Lutzomyia barrettoii majuscula* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, G. Genital pump and filaments, same scale as Fig. 47F, H. Spermathecae, I. Female wing, J. Male wing, K. Female cibarium.

Male: Cerro Azul, Panama Prov., Panama

Female: Same locality as male

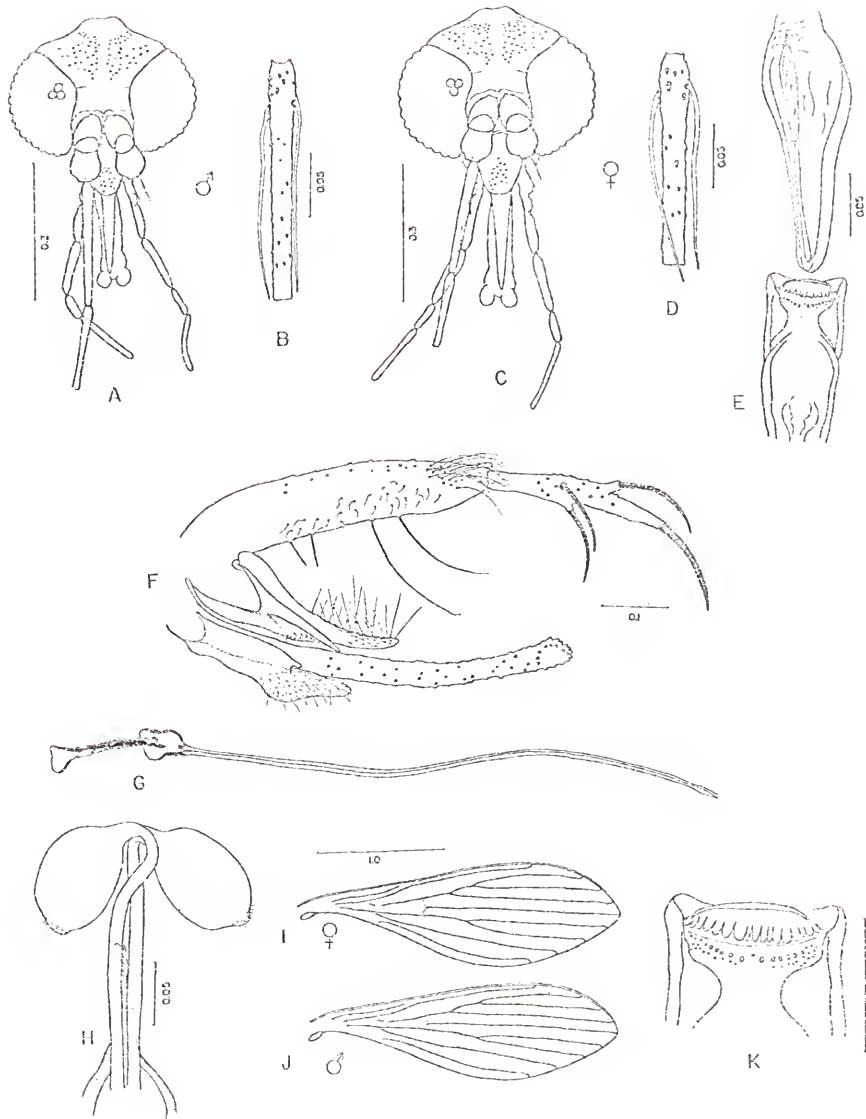




Figure 47

*Lutzomyia barrettoi majuscula* -- A. Spermatheca.

Female: Cerro Azul, Panama Prov., Panama

*Lutzomyia barrettoi barrettoi* -- B. Spermathecae, same scale as Fig. 46A, C. Tip of genital fork stem, D. Tip of genital fork stem, E. Tip of genital fork stem of female from Caqueta, Colombia, F. Female cibarium, G. Female flagellomere II, H. Male genitalia.

Male: Trinidad

Female: Trinidad (except Fig. 46E)

*Lutzomyia texana* -- I. Spermatheca, same scale as Fig. 46A.

Female: Sinton, Texas, U.S.A.

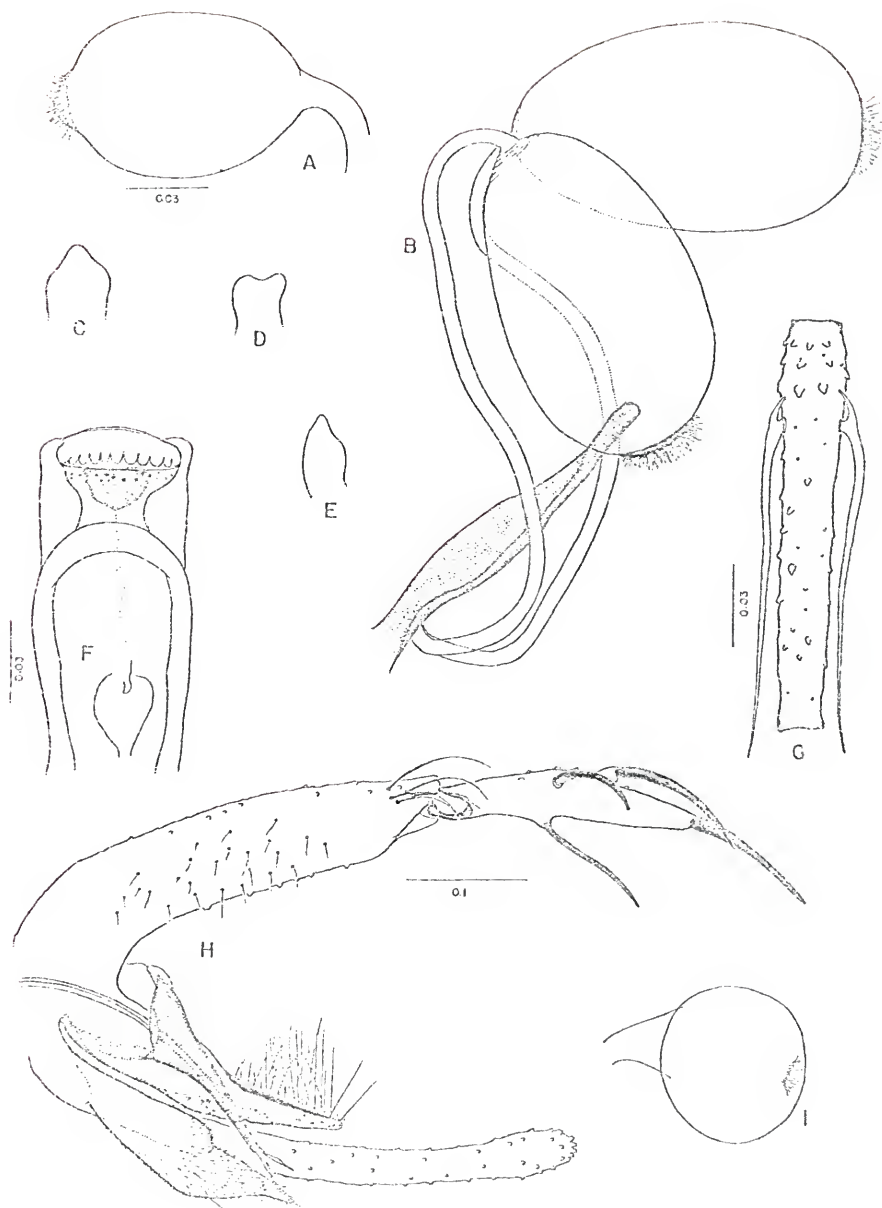


Figure 48

*Lutzomyia carpenteri* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Body of spermatheca, G. Genital pump and filaments, same scale as Fig. 48H, H. Male genitalia, I. Tips of genital filaments, J. Spermathecae, K. Female wing, L. Male wing, M. Female cibarium.

Male: Curiche, Choco Dept., Colombia

Female: Same locality as male

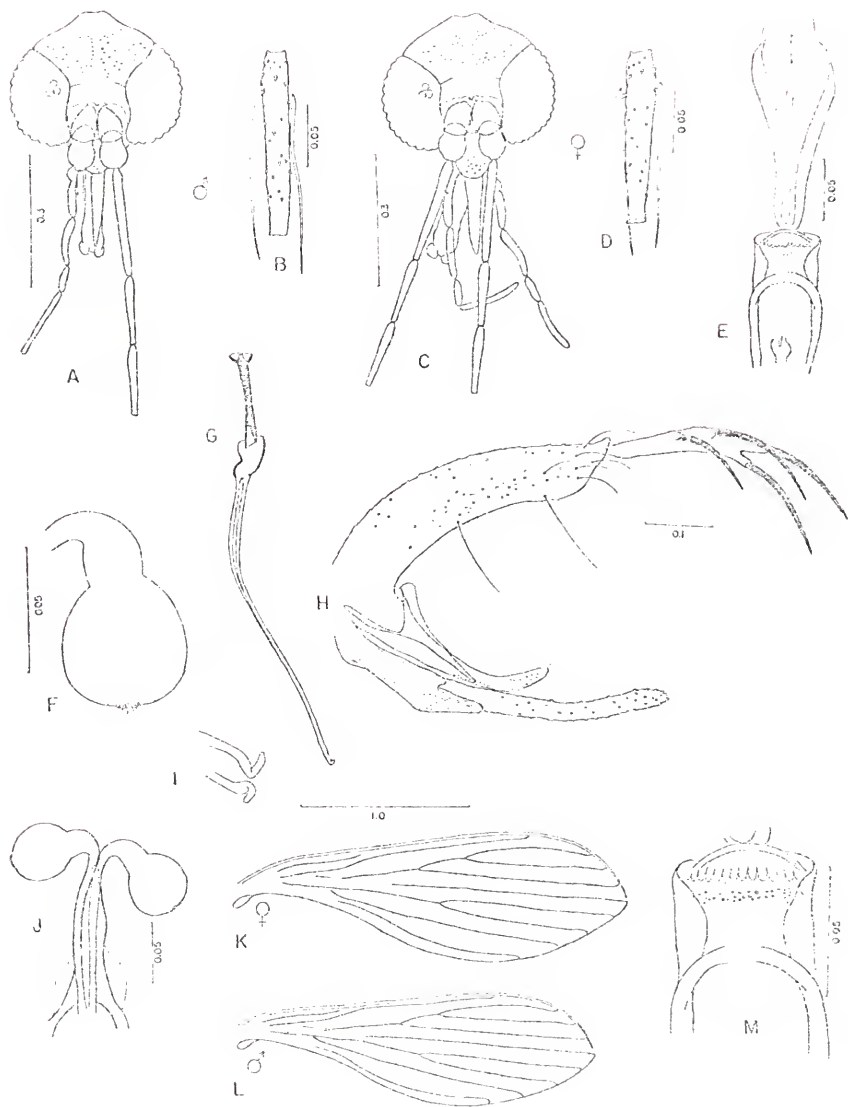
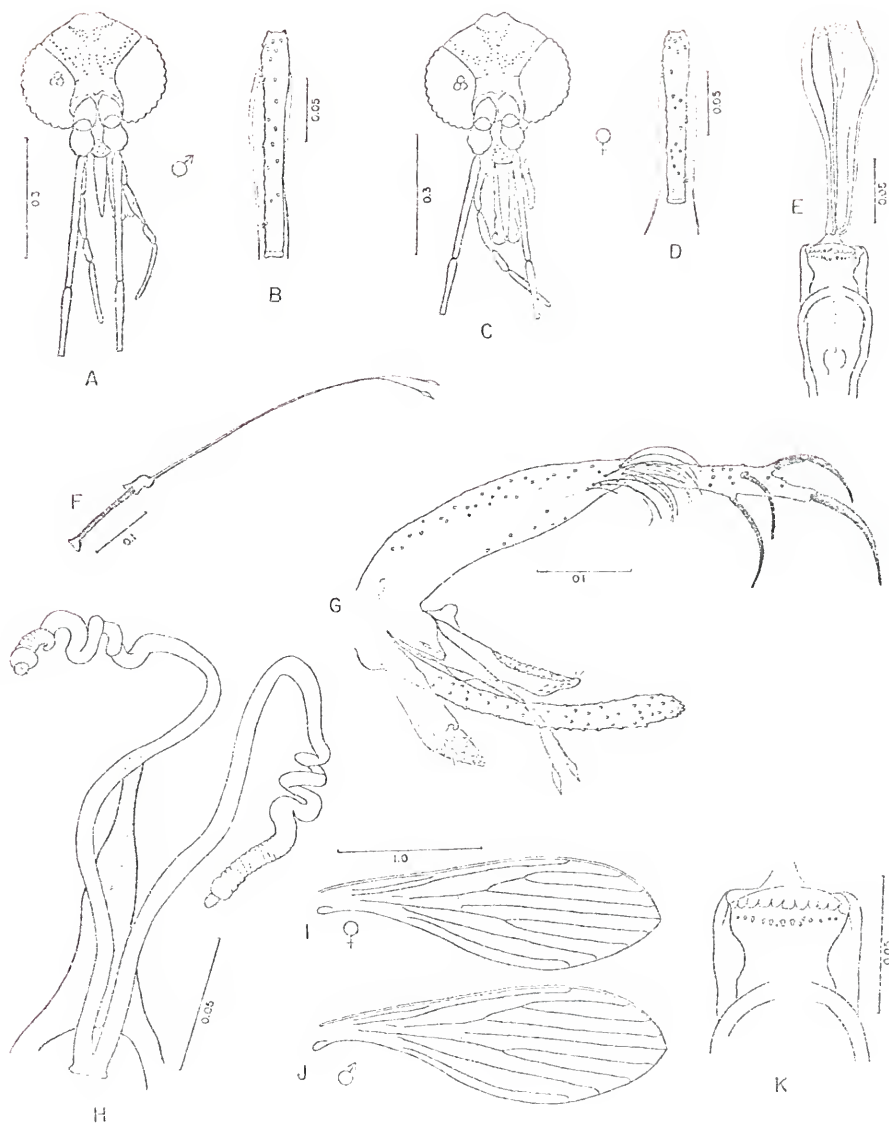


Figure 49

*Lutzomyia runoides* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and Pharynx, F. Genital pump and filaments, G. Male genitalia, H. Spermathecae, I. Female wing, J. Male wing, K. Female cibarium.

Male: Rio Anori, Antioquia Dept., Colombia

Female: Same locality as male



Dreisbachi Group Lewis et al., 1978

By virtue of the annulated spermathecae and cibarial armature, the females of this group resemble those in the subgenera *Nyssomyia* Barretto and *Trichophoromyia* Barretto but the ascoids have long posterior spurs and the males have 2 or more strong distal setae on each coxite.

Four species comprise the *dreisbachi* group, two of which occur allopatrically in Colombia. The females ordinarily do not attack man and are very similar, if not indistinguishable, in structural details. Without associated males or knowledge of locality, I am unable to identify them beyond the group level.

Key to Species

Males

1. Paramere simple but with modified dorsal seta at apex and tuft of apically recurved setae near middle. Coxite with 2 large modified setae at ventral median surface . . . . . *aelydifera* (Fig. 50)
- Paramere bifurcate; it & coxite without modified setae. . . . .  
. . . . . *dreisbachi* (Fig. 51)

59. *Lutzomyia aelydifera*  
(Fig. 50)

*Phlebotomus aelydiferus* Fairchild & Hertig, 1952: 511 (♂ holotype, Mojinga Swamp, near Gatun, Canal Zone; ♀, Juan Mina, Canal Zone). Fairchild & Hertig, 1959: 121 (Mexican & Central American records). Johnson & Hertig, 1961: 765, 773 (rearing data). Hanson, 1968: 44 (larva, pupa, descr., figs.).

*Lutzomyia aclydifera*: Theodor, 1965: 193, 194 (♂, ♀ figs., listed). Barreto, 1969: 462 (Valle, Colombia). Sherlock & Guitton, 1970: 140 (classif.). Martins et al., 1970a: 550 (cf. to *hermanlenti*). Chaniotis et al., 1971a: 344 et seq. (pop. dynamics, Panama). Young, 1972a: 312 (mention). Martins & Morales, 1972: 365 (listed). Osorno et al., 1972a: 61 (mention). Chaniotis et al., 1972: 95 (resting sites, mostly burrows). Christensen, 1972a: 88 (listed). Christensen et al., 1972: 57 et seq. (collecting data). Chaniotis & Correa, 1974: 115 (light trap data). Rutledge et al., 1975: 181 (light trap data). Rutledge & Ellenwood, 1975a: 72 (breeding on open forest floor). Lewis, 1975a: 502 et seq. (mouthpart morphol.). Martins et al., 1976a: 493 (cf. to *ruparupa*). Herrero & Christensen, 1976a: 62 (collecting data).

*Psychodopygus aclydiferus*: Forattini, 1971a: 105 (listed), Forattini, 1973: 189 et seq. (gen. review, figs.). Gomes, 1975: 9 (listed).

*Distribution*: Mexico, Honduras, Nicaragua, Costa Rica, Panama, Colombia (Antioquia, Choco, Valle), Ecuador.

*Material examined*: Colombia. 58 ♂♂, 16 ♀♀, Rio Anori (Antioquia), light traps, May 1970, C.H.P. 6 ♂♂, 6 ♀♀, same data but Sept. 1970, D.G.Y. 190 ♂♂, 296 ♀♀, Curiche (Choco), light, Shannon & Malaise traps, tree trunks, April-Dec. 1967, D.G.Y. 26 ♂♂, 28 ♀♀, Alto Curiche (Choco), light & Shannon traps, Aug.-Nov. 1967, D.G.Y. 28 ♂♂, 59 ♀♀, Teresita (Choco), light & Shannon traps, June-Nov. 1967, D.G.Y. 1 ♀, Anchicaya Dam (Valle), light trap, 11 Aug. 1973, D.G.Y. & R.C.W. Ecuador. 15 ♂♂, 10 ♀♀, 17 km E of Santa Domingo de los Colorados (Pichincha), light & Malaise traps, May 1976, D.G.Y., T. Rogers, & G. Fairchild. Panama. ♂ holotype, ♀ allotype and 50+ specimens from various localities, most of which were listed by Fairchild & Hertig (1952).



*Discussion:* At Curiche, *L. aelydifer* was the most abundant phlebotomine species taken in light traps from April to Dec., 1967 (39 trap nights). Of a total catch of 1167 specimens (23 species), accounted for 30% or 350 specimens (155 ♂♂, 195 ♀♀).

The feeding habits of this species remain unknown.

60. *Lutzomyia dreisbachi*  
(Fig. 51)

*Phlebotomus dreisbachi* Causey & Damasceno, 1945: 649 (♂ holotype, Coari, Rio Solimoes, Amazonas, Brazil). Barretto, 1947: 197 (refs.). Damasceno et al., 1949: 824 (Brazilian records). Barretto, 1950a: 106 (♂ keyed). Barretto, 1951: 216 (distrib.). Floch & Abonnenc, 1952: 20 et seq. (♂, ♀, keyed, redescri., figs., French Guiana). Vargas & Diaz-Nájera, 1953a: 49 (listed).

*Lutzomyia dreisbachi*: Theodor, 1965: 185 (listed). Martins et al., 1965: 2 (Rondonia, Brazil). Sherlock & Guitton, 1970: 140 (classif.). Martins et al., 1970: 550 (cf. to *hermanlenti*). Young, 1972a: 312 (mention). Martins & Morales, 1972: 367 (listed). Martins et al., 1976a: 493 (cf. to *ruparupa*). Martins et al., 1976b: 498 (mention).

*Psychodopygus dreisbachi*: Forattini, 1971a: 105 (listed). Forattini, 1973, 390 et seq. (gen. review, figs.). Gomes, 1975: 9 (listed).

*Distribution:* Brazil, French Guiana, Colombia (Amazonas).

*Material examined:* Colombia. 1 ♂, 17 km W of Leticia (Amazonas), light trap, 26 July 1973, D.G.Y. & R.C.W.

*Discussion:* A little known Amazonian species, *L. dreisbachi* was discovered first in an armadillo burrow in Amazonas, Brazil, where over 2,000 males were captured (Causey and Damasceno, 1945). Future collections

should reveal its presence in other localities within the Amazon Basin.

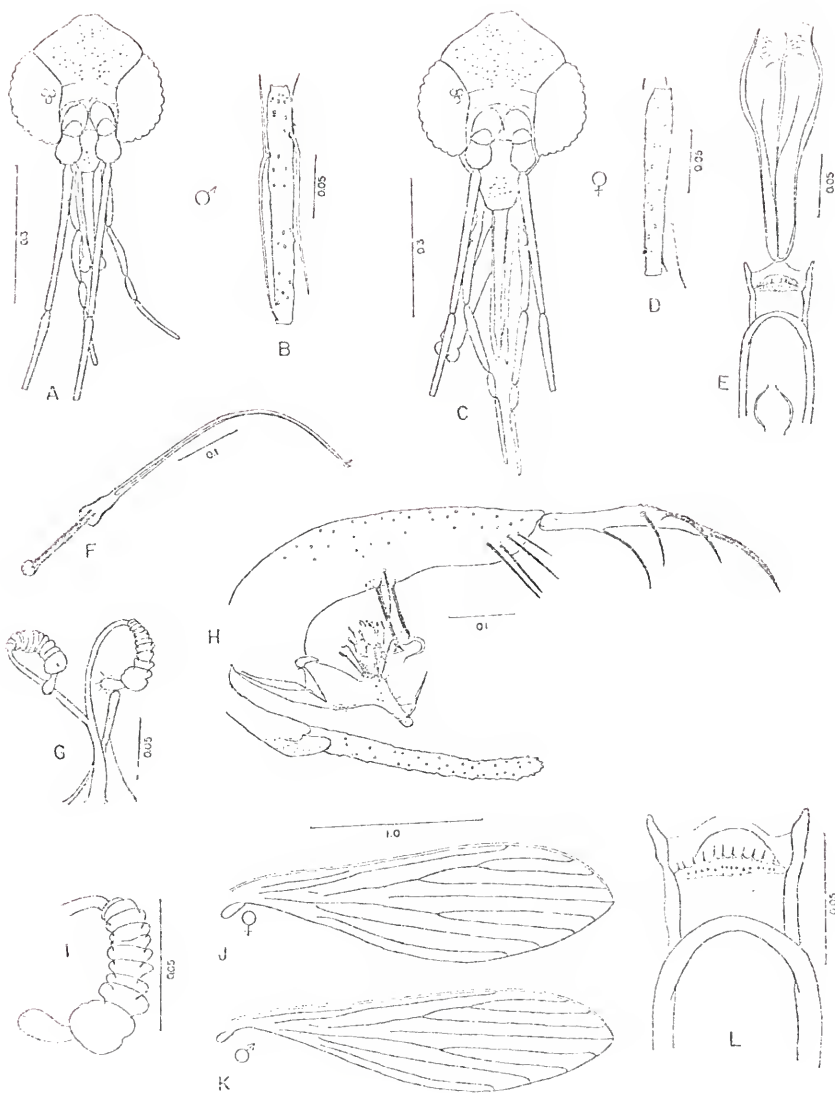
I have not examined females of this species but a description and good figures are provided by Floch and Abonnenc (1952).

Figure 50

*Lutzomyia aclydifera* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Genital pump and filaments, G. Spermathecae, H. Male genitalia, I. Body of spermatheca, J. Female wing, K. Male wing, L. Female cibarium.

Male: Curiche, Choco Dept., Colombia

Female: Same locality as male



Subgenus *Trichophoromyia* Barretto, 1962

This is a distinct group as treated by Barretto (1962) and Sherlock and Guitton (1970), the species of which occur in or near the Amazon Basin except for *L. reburra*.

The 20+ *Trichophoromyia* species, especially females, resemble those in the subgenus *Nyssomyia* Barretto, 1962, as noted by several authors. Forattini (1971a, 1973) in fact enlarges *Trichophoromyia* to accomodate these and other species, some of which such as *L. hartmanni* (Fairchild and Hertig), *L. sanguinaria* (Fairchild and Hertig), *L. fluviatilis* (Floch and Abonnenc), and *L. nordestina* (Mang.) do not appear to be closely related to the others based on a combination of characters.

Sherlock and Guitton (1970) provide a useful key to the *Trichophoromyia* males. The few described females, being similar in structure, are difficult to identify in the absence of males.

At present, 6 *Trichophoromyia* species are known to occur in Colombia but others certainly exist in the Amazonian region. The species are attracted to lights but their preferred resting sites and hosts remain virtually unknown. None of the species, unlike those of *Nyssomyia*, is known to be anthropophilic.

Key to Species

Males

1. Genital filaments less than 4 times length of pump. . . . . 2
- Genital filaments greater than 4 times length of pump . . . . . 3

2. Paramere broader, less clubbed, most of dorsal setae sinuous. Eyes large, separated by less than 4 facet diameters . . . *reburra* (Fig. 54)
- Paramere otherwise, dorsal setae straight or nearly so. Eyes smaller, separated by more than 6 facet diameters. . . . *ubiquitalis* (Fig. 51)
3. Coxite with only a distal group of 4-6 straight setae. Paramere as shown . . . . . *saltuosa* (Fig. 53)
- Coxite with basal and/or median tufts, the total number of setae greater than 10. Paramere otherwise. . . . . 4
4. Coxite with 3 groups of setae, a basal patch of about 7 short setae, a row of 4 longer hairs on median ventral surface & a distal patch of about 8 slender setae. Paramere as shown. . . *cellulana* (Fig. 52)
- Coxite with 1 or 2 groups of setae. Paramere otherwise . . . . . 5
5. Coxite tuft circular and compact, the tips of nearly all setae downwardly curved . . . . . *howardi* (Fig. 53)
- Coxite tuft otherwise, the setae loosely arranged, the tips of most not downwardly curved . . . . . *auraensis* (Fig. 51)

61. *Lutzomyia* (T.) *auraensis*  
(Fig. 51)

*Phlebotomus auraensis* Mangabeira, 1942a: 161 (♂ holotype, Aura, Belem, Para, Brazil). Barretto & Coutinho, 1943: 188 (mention). Damasceno et al., 1949: 819 (Brazilian records). Barretto, 1950a: 108 (o keyed). Vargas & Diaz-Nájera, 1951a: 22 (mention). Barretto, 1951: 212 (Brazilian records). Floch & Abonnenc, 1952: 36 (♂ keyed). Llanos, 1964: 373-375 (? *auraensis*, ♂ redescri., figs., Peru).

*Lutzomyia auraensis*: Barretto, 1962: 97 (listed). Martins et al., 1965: 2 (Rondonia, Brazil). Theodor, 1965: 185 (listed, ♂, ♀ figs.). Sherlock & Guitton, 1970: 143 et seq. (♂, keyed, fig.). Osorno et al., 1972a: 37 (Caqueta, Colombia). Velasco, 1973: 82 (Bolivia). Lewis, 1975a: 500 et seq. (mouthpart morphol.). Llanos et al., 1975b: 669 (Peru). Llanos et al., 1976: 480 (Peru). Martins et al., 1976b: 495 (Peru).

*Psychodopygus auraensis*: Forattini, 1973: 416 et seq. (gen. review, figs.).

*Distribution*: Colombia (Caqueta), Brazil, Peru, Bolivia.

*Material examined*: Colombia. 3 ♂♂, Tres Esquinas (Caqueta), light trap, 10 Nov. 1971, C.J.M. Bolivia. 2 ♂♂, Tajlewi (Larecaja), light trap, 13 Aug. 1971, J. Velasco. Brazil. 1 ♂, Rio Guama, Belem (Para), 23 Nov. 1959, J. Silva. Peru. 4 ♂♂ (Madre de Dios), A Cornejo, no other data.

*Discussion*: I have not examined *auraensis* females but Theodor (1965) illustrates the spermatheca and cibarium, both of which resemble those of *L. ubiquitalis*, *L. viannamartinsi* Sherlock and Guitton, and most other described females.

The Colombian males compare favorably with a Brazilian topotype and I consider them to be the same. The male described as *auraensis* from Peru by Llanos (1964) differs from the topotype and Mangabeira's original description (1942a) in the setation of the coxite. Her description of *L. loretonensis* (Llanos, op. cit.), in fact, resembles *L. auraensis* more closely and may prove to be that species but I have not studied the holotype.

62. *Lutzomyia* (T.) *cellulana* n. sp.  
(Fig. 52)

*Male*: Wing length 1.91; width 0.52. Whole insect dusky, mesonotum darker than pleura. Head height 0.34; width 0.33. Eyes separated by 0.11 or by distance = to 6.6 facet diameters. Flagellomere I (0.20 long), combined length of flagellomeres I and II = 0.24; ascoids with short posterior spurs, the distal tips of those on flagellomere II reaching beyond end of flagellomere, on flagellomeres 2-8, remainder missing. Length of palpal segments: 1 (0.03), 2 (0.08), 3 (0.13), 4 (0.05), 5 missing; palpal sensilla at end of segment 2 and on distal two-thirds of the third. Labrum 0.20 long. Cibarium with vestiges of teeth, mostly dot-like but 3 slender ones present; cibarial arch and pigment patch invisible. Pharynx 0.14 long. Pleura with 11-12 upper and 4 lower episternal setae. Length of wing vein sections: *Alpha* (0.51), *beta* (0.27), *delta* (0.31), *gamma* (0.20). Legs missing. Abdominal sternites 2-6 entire, lacking clear or open areas. Genitalia: Style (0.21 long) with 4 major spines inserted at different levels, no subterminal seta. Coxite (0.35 long x 0.15 wide), with 2 median groups of long setae and a group of 7 very small setae at base as shown. Paramere subtriangular apically. Aedeagus stout. Lateral lobe 0.44 long. Genital pump (0.18 long), each filament ca. 0.92 long or 5.1 x length of pump, filament tips expanded. Cerci as shown.

*Female*: Wing length 2.45; width 0.69. Coloration as in ♂. Head Height 0.40; width 0.37. Eyes separated by 0.14 or by distance = to 7.9 facet diameters. Flagellomere I (0.20 long), combined length of flagellomeres II and III = 0.27; ascoids as in ♂, on all but last flagellomere. Length of palpal segments: 1 (0.04), 2 (0.12), 3 (0.15), 4 (0.05),



5 (0.11); palpal sensilla as in ♂. Labrum 0.29 long. Cibarium with 18-20 horizontal teeth, those at extreme sides difficult to observe, with about 30 vertical teeth arranged as shown; cibarial arch complete though hardly visible in middle; pigment patch well infuscated, subtriangular. Pleura with 26 upper and 5 lower episternal setae. Length of wing vein sections: *Alpha* (0.70), *beta* (0.29), *delta* (0.46), *gamma* (0.25). Length of femora, tibiae, and basitarsi: Foreleg, 0.86, 1.12, 0.74; midleg, 0.84, 1.37, 0.83; hindleg, 0.93, 1.62, 0.90. Abdominal sternites not completely visible but apparently lacking clear or open areas. Tergite 8 with 10 setae on each side. Spermathecae as shown, cylindrical with complete annulations, the terminal one button-like, larger than others; sperm ducts as shown. Cerci rather broad and short.

*Distribution:* Colombia (Caqueta).

*Material examined:* Colombia. 1 ♂ (holotype no. 612), Tres Esquinas (Caqueta), light trap, 10 Nov. 1971, C.J.M. 1 ♀ (allotype no. 613), same data as male.

*Discussion:* The male of *L. cellulana* differs from the other *Trichophoromyia* males in several characteristics including the shape of the parameres, the presence of a cluster of 7 or so short setae at the base of the coxite, and the number and nature of coxite setae in the other two groups.

There is a strong possibility that the female described above is not the female of *cellulana*. Further collections and/or rearing studies will be necessary to confirm the association. I am describing the specimen, however, because it differs from other known *Trichophoromyia* females in the spermathecae and because it and the *cellulana* male were captured together, *L. auraensis* being the only other *Trichophoromyia* species taken in the light trap at Tres Esquinas.

The specific name refers to "hermit" or "recluse" owing to the possibility that the single known male may not be conspecific with the female.

63. *Lutzomyia (T.) howardi* n. sp.  
(Fig. 53)

*Male*: Wing length 2.03; width 0.61. Whole insect dusky, mesonotum darker than pleura. Head height 0.36; width 0.35. Eyes separated by 0.13 or by distance = to 7 facet diameters. Flagellomere I (0.22 long), combined length of flagellomeres II and III = 0.26; ascoids with short posterior spurs, the tips of ascoids on flagellomere II reaching beyond distal end, on all flagellomeres except last 2. Length of palpal segments: 1 (0.04), 2 (0.09), 3 (0.14), 4 (0.06), 5 (0.15); palpal sensilla at end of segment 2 and on distal two-thirds of the third. Labrum 0.21 long. Cibarium with ca. 15 dot-like vestiges of teeth; chitinous arch and pigment patch invisible. Pharynx (ca. 0.15 long but awkwardly turned due to mounting). Pleura with 13-15 upper and 5 lower episternal setae. Length of wing vein sections: *Alpha* (0.54), *beta* (0.27), *gamma* (0.21), *delta* (0.36). Length of femur, tibia, and basitarsus of hind leg, 0.91, 1.52, and 0.86 respectively; other legs missing. Abdominal sternite 2 entire, without clear or open areas. Genitalia: Style (0.21 long), with 4 major spines at different levels, no subterminal seta. Coxite (0.41 long x 0.13 wide) with a dense median tuft of 30+ setae, most downwardly curved apically, 7 or so straight setae below those of the tuft. Paramere as shown, with a setose lobe on dorsal surface. Aedeagus stout with pointed tips. Lateral lobe (0.44 long). Genital pump (0.16 long), each filament ca. 0.93 long or 5.8 x length of pump;

filament tip pointed, slightly expanded subapically. Cerci as shown.

*Distribution:* Colombia (Amazonas).

*Material examined:* Colombia. 1 ♂ (holotype no. 614), 17 km W of Leticia (Amazonas), light trap, 26 July 1973, D.G.Y. & R.C.W.

*Discussion:* The male of *howardi* differs from the other *Trichophoromyia* males in the structure of the genitalia, especially the shape of the parameres and the nature and position of the coxite tuft. The parameres of *L. brachipyga* (Mang.) and *L. viannamartinsi* Sherlock and Guitton are somewhat similar but they are more upturned apically and the setation is different. The coxites of these two Brazilian species are notably broader and there are 2 or more very strong setae in the coxite tuft.

The female of *howardi*, presently unknown, probably has long sperm ducts which correspond to the long ducts of the male. This species is named after my father in appreciation for his constant encouragement and assistance throughout this study.

64. *Lutzomyia* (T.) *reburra*  
(Fig. 54)

*Phlebotomus reburra* Fairchild & Hertig, 1961b: 246 (♂ holotype, La Zumbadora, Cerro Azul, Panama Prov., Panama; ♀, Rio Mandinga, Colon Prov., Panama).

*Lutzomyia reburra*: Barretto, 1962: 97 (listed). Lewis, 1967b: 136 (mention). Barreto, 1969: 466 (Valle, Colombia). Sherlock & Guitton, 1970: 141 et seq. (♂ keyed, fig.). Christensen & Fairchild, 1971: 301 (mention). Christensen, 1972a: 88 (listed). Osorno et al., 1972a: 37 (mention).

*Psychodopygus reburra*: Forattini, 1971a: 105 (listed). Forattini, 1973: 417 et seq. (gen. review, figs.). Gomes, 1975: 9 (listed).

*Distribution*: Panama, Colombia (Choco, Valle), Ecuador.

*Material examined*: Colombia. 178 ♂♂, 231 ♀♀, Curiche (Choco), Malaise, Shannon, & light traps, April-Nov., 1967, D.G.Y. 18 ♂♂, 11 ♀♀, Alto Curiche (Choco), Malaise, Shannon, & Light traps, June-Nov., 1967, D.G.Y. 38 ♂♂, 55 ♀♀, Anchicaya Dam (Valle), light & flight traps, tree trunks, 9-11 Aug. 1973, D.G.Y. & R.C.W. 57 ♂♂, 126 ♀♀, 25 km E of Buenaventura (Valle), flight trap, 12 Aug. 1973, D.G.Y. & R.C.W. 129 ♂♂, 110 ♀♀, same data but light trap. Ecuador. 1 ♀, Puerto Quito (Pichincha), light trap, 30 Aug. 1976, J. Cohen. Panama. 1 ♂ (holotype no. 6427), type locality, Shannon trap, 12 Sept. 1957. 1 ♀ (allotype no. 6414), Rio Mandinga (Colon), Shannon trap, 10 May 1957, P. Galindo & A. Adames.

*Discussion*: The *reburra* female is recognized by the refringent excrescences on the individual sperm ducts, the elongate terminal knobs of the spermathecae, and the dark mesonotum and pleura. The female of *L. (Nyssomyia) yuilli* Young and Porter also has excrescences on the sperm ducts but it is a pale species occurring east and slightly north of the Andes unlike *reburra* which is restricted to Pacific coast forests in Ecuador and Colombia. It was first discovered in Panama but is much less common there.

At Curiche, we collected 798 specimens of 24 phlebotomine species in a Malaise trap operated continuously at ground level from April to December, 1967. *Lutzomyia reburra* was the dominant species taken, accounting for 137 ♂♂, 145 ♀♀ (31%) of the total catch. This species is readily attracted to light, one notable light trap catch (listed above) near Buenaventura yielding many specimens, some of which were observed

in copula. We did not observe females attacking man at Curiche or elsewhere nor did we discover the preferred resting sites.

65. *Lutzomyia* (T.) *saltuosa* n. sp.  
(Fig. 53)

*Male*: Wing length 2.05; width 0.61. Whole insect dusky, mesonotum darker than pleura. Head height 0.38; width 0.34. Eyes separated by 0.12 or by distance = to 7 facet diameters. Flagellomere I (0.23 long), combined length of flagellomeres II and III = 0.25; ascoids with short posterior spurs present, on all flagellomeres except last 2; tips of ascoids on flagellomere II extending beyond the end of flagellomere. Length of palpal segments: 1 (0.04), 2 (0.11), 3 (0.14), 4 (0.06), 5 missing; palpal sensilla at end of segment 2 and on distal two-thirds of segment 3. Labrum 0.25 long. Cibarium with six needle-like horizontal teeth; 3 in a row on one side, the others irregularly spaced, all more or less erect; vertical teeth (ca. 25) subequal in size, in 3 irregular rows; cibarial arch obvious at sides, invisible in middle; pigment patch subtriangular, conspicuous. Pharynx 0.19 long. Pleura with 9 upper and 5 lower episternal setae. Length of wing vein sections: *Alpha* (0.61), *beta* (0.30), *delta* (0.42), *gamma* (0.17). Legs missing. Abdominal sternites 2-6 entire, without clear or open areas. Genitalia: Style (0.25 long), with 4 major spines at different levels, no subterminal seta. Coxite (0.40 long x 0.12 wide) with 4-6 straight, rather strong setae distally. Paramere and aedeagus as shown. Lateral lobe 0.46 long. Genital pump (0.17 long), each filament ca. 0.90 long or 5.3 x length of pump; filament tips simple, very slightly enlarged apically. Cerci as figured.

*Distribution:* Colombia (Amazonas).

*Material examined:* Colombia. 1 ♂ (holotype no. 615), 17 km W of Leticia (Amazonas), light trap, 26 July 1973, D.G.Y. & R.C.W.

*Discussion:* A distinctive species of *Trichophoromyia*, *L. saltuosa* is easily recognized by the 4-6 straight setae on the distal part of the coxite and by the shape of the parameres.

The specific name is based on the Latin word, "saltuosus," meaning forested or woody, the unique holotype having been captured in a well developed forest about 2 km from the Amazon river.

66. *Lutzomyia* (T.) *ubiquitalis*  
(Fig. 51)

*Phlebotomus ubiquitalis* Mangabeira, 1942a: 158 (♂ holotype, Aura, Belem, Para, Brazil). Damasceno et al., 1949: 833 (Brazilian records). Vargas & Diaz-Nájera, 1951a: 22 (mention). Barretto, 1951: 225 (Brazilian records). Barretto, 1954: 124 (refs.). Forattini, 1960: 476 (Amapa, Brazil). Fairchild & Hertig, 1961b: 248 (cf. to *returrus*). Pifano et al., 1962: 384, 385 (♂, in key to phlebotomines of Venezuela).

*Phlebotomus cauchensis* Floch & Abonnenc, 1943: 22 (♂, Caux, French Guiana). Barretto, 1947: 192 (full refs.). Floch & Abonnenc, 1952: 104-107 (♂, ♀, redescr., figs.). Barretto, 1954: 124 (as synonym of *ubiquitalis*).

*Phlebotomus basispinosus* Barretto & Coutinho, 1943: 185 (♂, S. Jose dos Campos, Sao Paulo, Brazil). Barretto, 1962: 97 (as synonym of *ubiquitalis*). Forattini, 1971a: 103 (listed as valid species). Forattini, 1973: 481 (as synonym of *ubiquitalis*).

*Lutzomyia ubiquitalis*: Barretto, 1962: 97 (listed). Martins et al., 1963: 335 (Roraima, Brazil). Martins et al., 1965: 4 (Rondonia, Brazil). Lewis, 1967b: 136 (♀ cf. to *rostrans*, refs.). Sherlock & Guitton, 1970: 139 et seq. (classif., ♂ keyed, fig.). Lewis et al., 1970: 215 (parous rates). Osorno et al., 1972a: 37 (Caqueta, Colombia). Lewis, 1975a: 500 et seq. (mouthpart morphol.). Lewis, 1975b: 366 (distrib. of abdominal setae, fig.). Ramirez et al., 1976: 599 (Amazonas, Venezuela).

*Psychodopygus ubiquitalis*: Forattini, 1971a: 105 (listed). Forattini, 1973: 417 et seq. (gen. review, figs.).

*Distribution*: Colombia (Caqueta), Brazil, French Guiana, Venezuela.

*Material examined*: Colombia. 1 ♂ (INPES no. 7099), Finca San Miguel, Milan, Municip. Florencia (Caqueta), tree hole, 25 Aug. 1971, E. Osorno, A. Morales, & J. Ochoa. Brazil. 3 ♂♂, Serra do Navio (Amapa), light trap, 21 Sept. 1972, D.G.Y. & H. Fraiha. 1 ♂, 27 km SE of Maraba (Para), light trap, 28 Sept. 1972, D.G.Y. 1 ♂, W of Altamira (Para), light trap, 1 Oct. 1972, D.G.Y. 3 ♂♂, Belem (Para), light trap, 18 Oct. 1972, D.G.Y.

*Discussion*: *Lutzomyia ubiquitalis*, the type species of the subgenus, is widespread in the Amazon Basin, the single Colombian specimen, a male, having been captured in Caqueta Department (Osorno et al., 1972a).

The female, not seen by me, was described and figured by Floch and Abonnenc (1942b as *Phlebotomus* sp. and 1952 as *cauchensis*).

Figure 51

*Lutzomyia dreisbachi* male -- A. Genitalia.

Male: Leticia, Amazonas Comisaria, Colombia

*Lutzomyia (T.) auraensis* male -- A. Genitalia.

Male: Tres Esquinas, Caqueta Intendencia, Colombia

*Lutzomyia (T.) ubiquitalis* male -- A. Genitalia.

Male: Belém, Pará State, Brazil



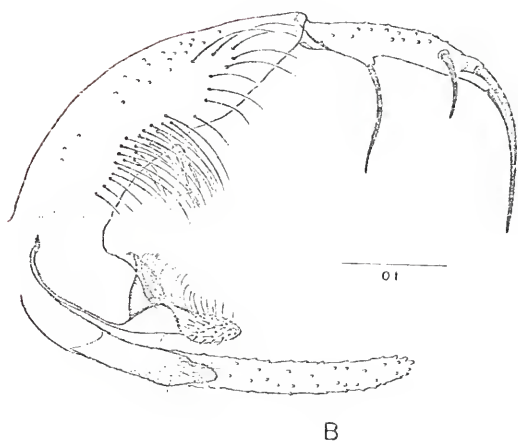
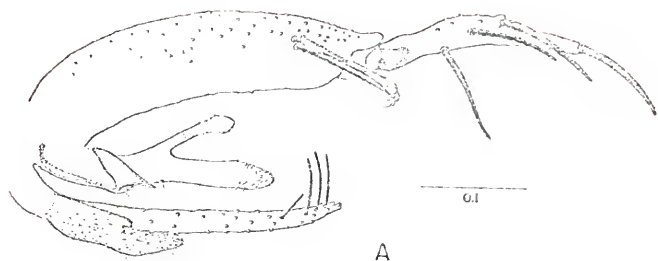


Figure 52

*Lutzomyia (T.) cellulana* -- A. Male head, B. Female head, same scale as Fig. 52A, C. Female flagellomere II, D. Female cibarium, E. Male genitalia, F. Tip of genital filament, G. Genital pump and filaments, H. Spermathecae, I. Female wing, J. Male wing.

Male: Tres Esquinas, Caqueta Intendencia, Colombia

Female: Same data as male

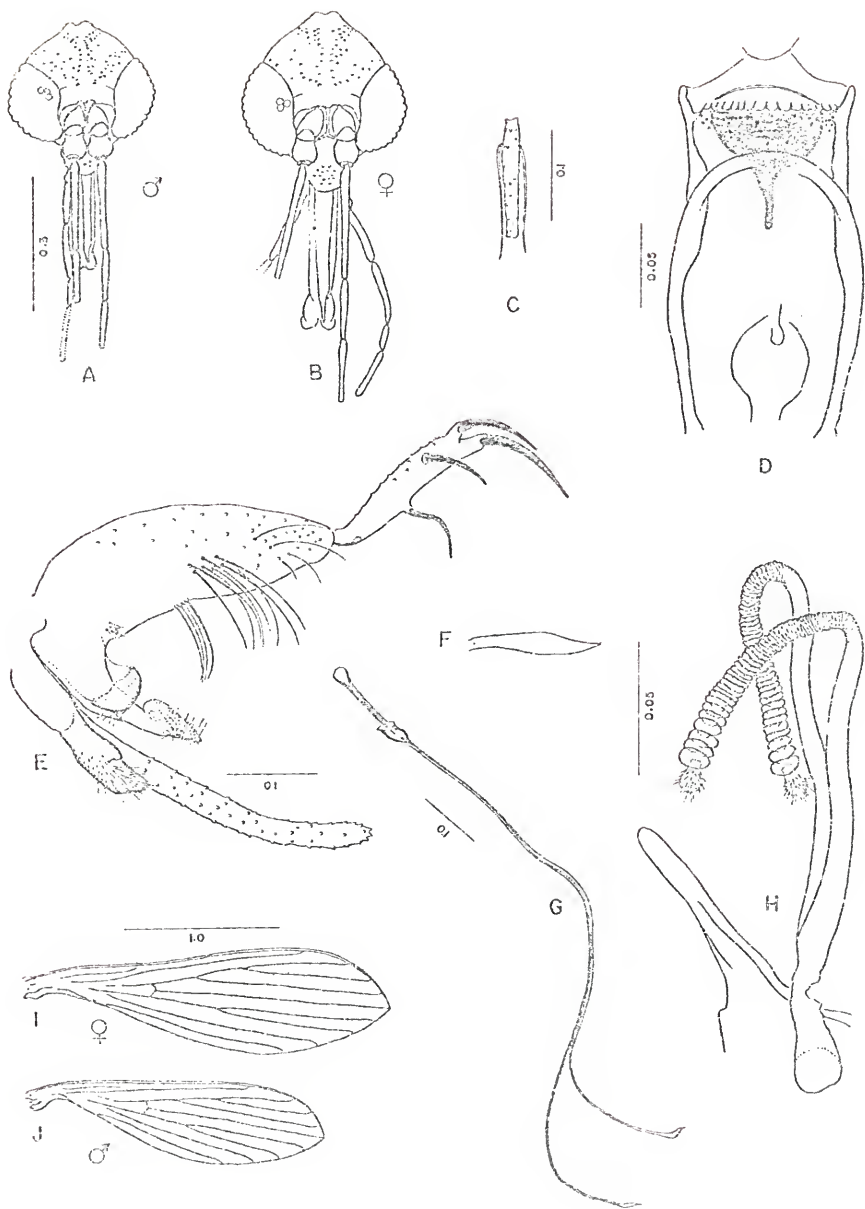


Figure 53

*Lutzomyia (T.) howardi* male -- A. Genitalia, B. Wing, C. Head, D. Flagellomere II, E. Tip of genital filament, F. Genital pump and filaments.

Male: Leticia, Amazonas Comisaria, Colombia

*Lutzomyia (T.) saltuosa* male -- G. Wing, H. Genitalia, I. Head, J. Flagellomere II, K. Tip of genital filament, L. Genital pump and filaments.

Male: Leticia, Amazonas Comisaria, Colombia

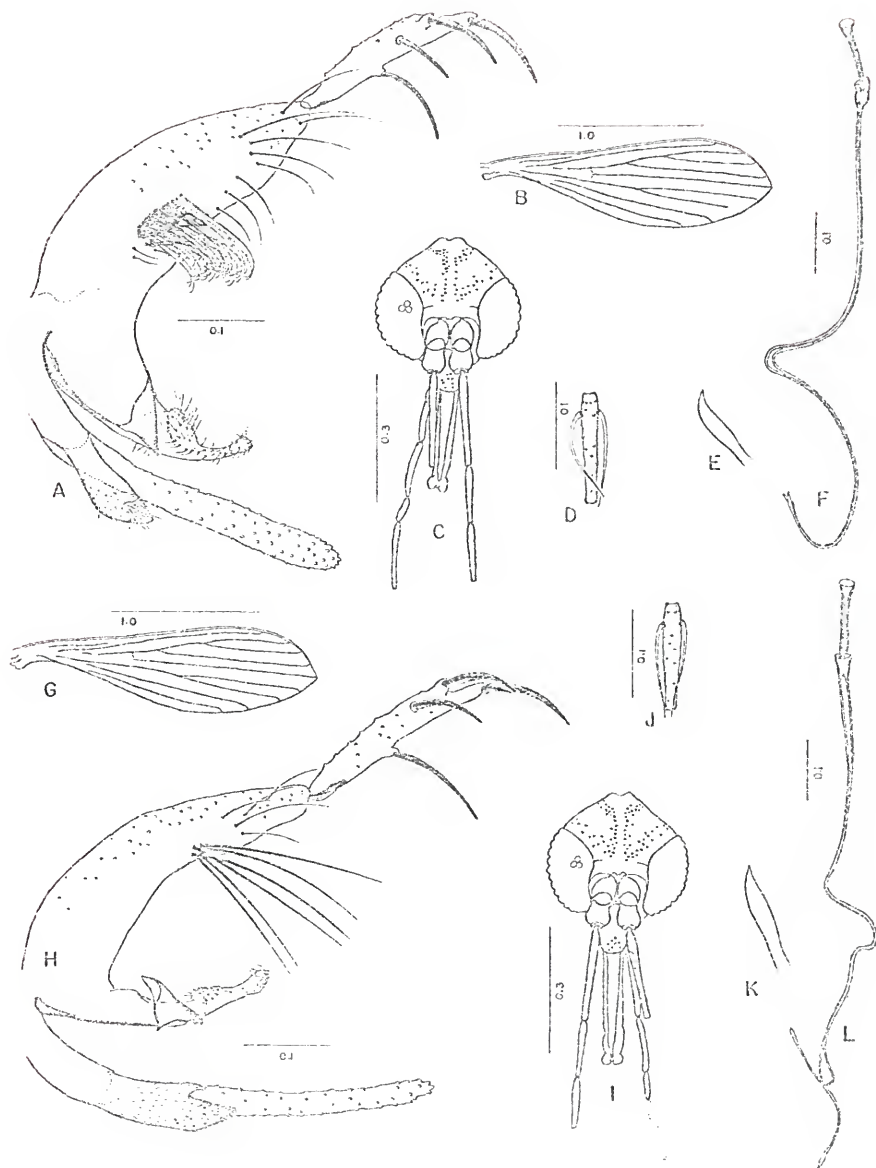
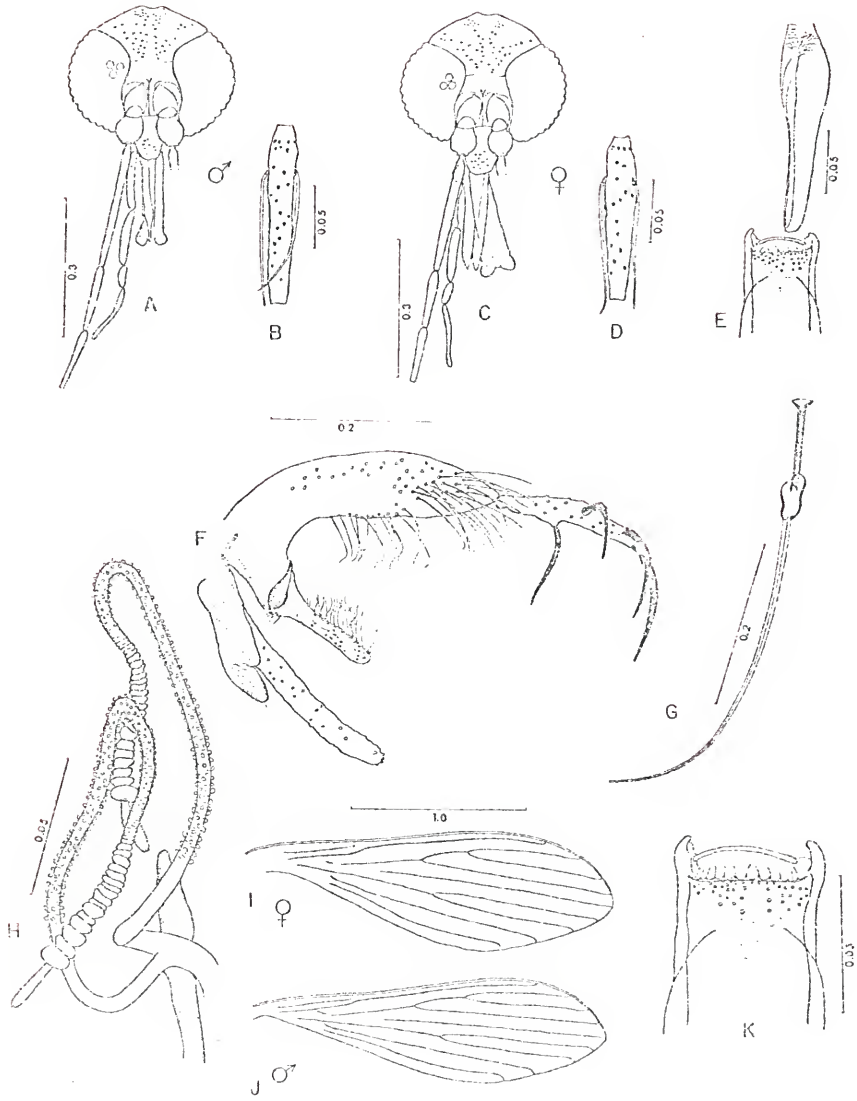


Figure 54

*Lutzomyia (T.) reburra* --- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, G. Genital pump and filaments, H. Spermathecae, I. Female wing, J. Male wing, K. Female cibarium.

Male: Curiche, Choco Dept., Colombia

Female: Same locality as male



Subgenus *Nyssomyia* Barretto, 1962

This subgenus is of special interest to public health workers as most of the included species are anthropophilic and are proven or probable vectors of cutaneous leishmaniasis (Lainson & Shaw, 1973) and certain arboviruses (Tesh et al., 1974).

The group was defined by several authors including Barretto (1962), Theodor (1965, as the *intermedia* group), and Forattini (1971a, 1973). The latter increased its coverage by including species in other subgenera and species groups recognized as distinct by Theodor (1965) and Lewis et al. (1978). The males of *L. antunesi* and *Lutzomyia* sp. no. 260.44 (Ward & Killick-Kendrick, 1974) have a definite group of setae on each coxite, lacking in the other *Nyssomyia* males.

Forattini (1973) reviewed the literature pertaining to most of these species and thus I restrict the citations to recent studies or to important earlier works.

To date, seven *Nyssomyia* species have been discovered in Colombia.

Keys to Species

Males

1. Coxite with a median group of 30+ setae . . . . . *antunesi* (Fig. 55)  
  
Coxite without a group of setae . . . . . 2
2. Style with all spines distal to middle of structure. Wing venation with *delta* shorter than half length of *beta*. Head and anterior part of mesonotum strongly pigmented . . . . . 3



- Style with basal pair of spines proximal to or at middle of structure.  
*Delta* = to or longer than *beta*. Head and mesonotum pigmented or  
 not . . . . . 4
3. Genital pump much longer than style and nearly as long as lateral  
 lobe. Flagellomere I (< 0.35 mm long), longer than II + III. . . .  
 . . . . . *flaviscutellata* (Fig. 55)
- Genital pump shorter or equal to length of style and shorter than  
 half length of lateral lobe. Flagellomere I (> 0.40 mm long), longer  
 than II + III . . . . . *olmeca bicolor* (Fig. 56)
4. Style with subterminal and terminal spines nearly paired, separated  
 by distance = to greatest width of terminal spine . . . . .  
 . . . . . *ylephiletor* (Fig. 59)
- Style with distal pair of spines more widely separated. . . . . 5
5. Genital filament tips slightly inflated, simple. Coxite longer than  
 lateral lobe. . . . . *trapidoi* (Fig. 57)
- Genital filament tips modified. Coxite and lateral lobe subequal in  
 length. . . . . 6
6. Genital filament tips forked, claw-like. Style over half length of  
 coxite or lateral lobe. Paramere somewhat acute at ventral basal  
 margin. Mesonotum partly pigmented . . . . . *unbratilis* (Fig. 58)
- Genital filament tips otherwise. Style shorter than or = to half  
 length of coxite or lateral lobe. Paramere rounded at lower basal  
 margin. Mesonotum pale . . . . . *yulli* (Fig. 60)

Females

1. Common sperm duct as long as or longer than individual ducts. . . . 2

Common sperm duct, if present, shorter than individual ducts. . . . 4

2. Head height subequal to width. Flagellomere I shorter than labrum.  
Spermatheca with fewer than 8 distinct segments, about 2 x length of  
individual sperm ducts. . . . . *antunesi* (Fig. 55)

Head much longer than wide. Flagellomere I = to or longer than  
labrum. Spermatheca with 9-12 distinct segments, = to or longer than  
individual ducts. . . . . 3

3. Flagellomere I = to or longer than II + III. Genital fork stem broad  
and blade-like. Cibarium with 8-10 (rarely 7) horizontal teeth . .  
. . . . . *olmeca bicolor* (Fig. 56)

Flagellomere I shorter than II + III. Genital fork stem slender.  
Cibarium with 6-7 horizontal teeth. . . . *flaviscutellata* (Fig. 55)

4. Individual sperm ducts mostly striated and/or with refringent ex-  
crescences (papules). . . . . 5

Individual sperm ducts smooth-walled. . . . . 6

5. Mesonotum pale. Individual sperm ducts with numerous excrescences  
forming a feather-like pattern. . . . . *yuilli* (Fig. 60)

Mesonotum pigmented in part. Individual sperm ducts transversely  
striated but lacking excrescences . . . . . *umbratilis* (Fig. 58)

6. Common sperm duct short but discernible. Spermathecae with segments increasing in size from base to apex. . . . . *ylephiletor* (Fig. 59)

Common sperm duct apparently absent. Spermathecae with segments subequal in size. . . . . *trapidoi* (Fig. 57)

67. *Lutzomyia* (N.) *antunesi*  
(Fig. 55)

*Phlebotomus antunesi* Coutinho, 1939: 181 (♂, Manacapuru, Amazonas, Brazil). Barretto, 1946b: 529-532 (refs., synonyms). Barretto, 1947: 185 (refs., synonyms). Damasceno et al., 1949: 818 (distrib., Brazil). Barretto, 1950a: 108 (keyed). Barretto, 1951: 212 (distrib.). Vargas & Diaz-Nájera, 1951a: 22 (mention). Floch & Abonnenc, 1952: 36 (♂ keyed), 99 (♂ redescr., figs.). Vargas & Diaz-Nájera, 1953a: 48 (mention). Fairchild, 1955: 195 (listed). Pifano et al., 1962: 386 (♂ keyed). Llanos, 1964: 372-373 (♂, redescr., figs., Peru). Wijers & Linger, 1966: 504 et seq. (biting man, Surinam). Leon, 1969: 30 (listed, Venezuela).

*Phlebotomus machicouensis* Floch & Abonnenc, 1944c: 8 (♀, Machicou, Moyen-Approuague, French Guiana). Barretto, 1947: 210 (refs.). Barretto, 1951: 219 (distrib.). Floch & Abonnenc, 1952: 43 (♀ keyed), 184 (♀ redescr., figs.). Fairchild, 1955: 194 (listed). Forattini, 1960: 477 (Amapa, Brazil).

*Lutzomyia antunesi*: Barretto, 1962: 97 (listed). Martins et al., 1963: 334 (Roraima, Brazil). Martins et al., 1964: 310 (= *machicouensis*). Martins et al., 1965: 2 (Rondonia, Brazil). Aitken et al., 1968: 264 (biting man, Trinidad). Lewis et al., 1970: 215 et seq. (parous rates). Fraiha et al., 1970b: 215 (mention). Martins et al., 1971: 417

(mention). Osorno et al., 1972a: 33-34 (Colombian records). Shaw & Lainson, 1972: 710 et seq. (Para, Brazil, negative for flagellates). Shaw et al., 1972: 720 (biting man, Para, Brazil). Llanos, 1973: 33 (in part, ♂ only, redescr., figs.). Ward & Ready, 1975: 128 et seq. (egg, descr., fig.). Lewis 1975a: 500 et seq. (mouthpart morphol., cibarium fig.). Lewis, 1975b: 366 (hair sockets, figs.). Martins et al., 1976a: 487 (Peru). Martins et al., 1976b: 495 (Peru). Llanos et al., 1976: 480 (Peru). Ramirez et al., 1976: 599 (Venezuela). Ward, 1976: 227 et seq. (larva, descr., fig., keyed). Lainson et al., 1977 (Mato Grosso, Brazil). Zimmerman et al., 1977: 575 (egg cf. to that of *ylephiletor*).

*Lutzomyia machicouensis*: Barretto, 1962: 98 (listed). Theodor, 1965: 184 (= *antunesi*).

*Psychodopygus antunesi*: Forattini, 1971a: 105 (listed). Forattini, 1973: 390 et seq. (gen. review, figs., synonyms).

*Distribution*: Colombia (Caqueta, Guajira, Vichada), Peru, Brazil, French Guiana, Venezuela, Trinidad.

*Material examined*: Colombia. 1 ♂, 15 ♀♀, Tres Esquinas (Caqueta), light trap, 10 Nov. 1971, C.J.M. Brazil. 2 ♀♀, Labrea (Amazonas), light trap, 10 Oct. 1972, D.G.Y. 9 ♂♂, 4 ♀♀, Serra do Navio (Amapa), tree trunks, 21 Sept. 1972, D.G.Y. & H. Fraiha. 1 ♂, 1 ♀, Rio Aripuana at Humboldt (Mato Grosso), tree trunks, 18-20 Aug. 1974, D.G.Y. & J. Shaw. 2 ♀♀, 27 km SE of Maraba (Para), light traps, 26-28 Sept. 1972, D.G.Y. & H. Fraiha. 1 ♀, Itiatuba (Para), light trap, 4 Oct. 1972, D.G.Y. & H. Fraiha. 3 ♂♂, 7 ♀♀, Belem (Para), tree trunks & flight trap, 29 July-5 Aug. 1974, D.G.Y. Trinidad. 25+ ♂♂, 30+ ♀♀, various localities, to be treated in a future article.

*Discussion:* Relatively common in and near Amazonia, *L. antunesi* is recognized by the median coxite tuft of 30+ setae, absent in other *Nyssomyia* males in Colombia and by the spermathecae with the long common duct of the females. As yet, there is no evidence incriminating this species in disease transmission but as a man-biter it should not be ruled out as a potential vector.

Llanos (1973) redescribed and figured the male and female of *L. antunesi*, the latter sex, however, not representing that species but probably *L. yuilli* Young and Porter.

68. *Lutzomyia* (*N.*) *flaviscutellata*  
(Fig. 55)

*Phlebotomus flaviscutellata* Mangabeira, 1942a: 144 (♂ holotype, Aura, Belem, Para, Brazil). Barretto, 1947: 201 (refs.).

*Phlebotomus apicalis* Floch & Abonnenc, 1943: 25 (♂, ♀, French Guiana). Barretto, 1946b: 534 (as synonym of *flaviscutellata*).

*Lutzomyia flaviscutellata*: Barretto, 1962: 98 (listed). Fairchild & Theodor, 1971: 153 et seq. (♂, ♀ redescr., figs., refs., distrib.). Shaw & Lainson, 1972: 709 et seq. (ecology, Para, Brazil). Shaw et al., 1972: 718 et seq. (feeding habits). Theiler & Downes, 1973: 287 (nat. infected with Icoaraci virus, Para, Brazil). Ward et al., 1973: 174 et seq. (collecting data). Aitken et al., 1975: 358 (as vector of Pacui virus). Ward & Ready, 1975: 128 et seq. (egg descr., fig.). Lewis, 1975a: 501 et seq. (mouthpart morphol.). Lewis 1975b: 363 et seq. (taxonomy, distrib.). Tikasingh, 1975: 228 et seq. (pop. dynamics, infected with *Leishmania*, Trinidad). Ward, 1976: 227 et seq. (immatures, descr., larval fig., keyed). Llanos et al., 1976: 480 (Peru). Martius,

1976b: 496 (Peru). Ward et al., 1977: 265-266 (bite transmission of *Leishmania mexicana amazonensis* to hamsters).

*Psychodopygus flaviscutellatus*: Forattini, 1971a: 105 (listed). Forattini, 1973: 170 et seq. (gen. review, refs., figs.). Gomes, 1975: 9 et seq. (review of disease relationships, ecology). Ward, 1977: 511 (adaptability to hosts and habits).

*Distribution*: Colombia (Amazonas), Ecuador, Peru, Brazil, Surinam, French Guiana, Venezuela, Trinidad.

*Material examined*: Colombia. 1 ♂, 17 km W of Leticia (Amazonas), forest floor, 24 July 1973, D.G.Y. & R.C.W. Brazil. 4 ♂♂, 13 ♀♀, 27 km SE of Marabá (Para), light traps, 26-28 Sept. 1972, D.G.Y. & H. Fraiha. 2 ♀♀, near Altamira (Para), light traps, 1 Oct. 1972, D.G.Y. & H. Fraiha. 1 ♂, Itiatuba (Para), light traps, 4 Oct. 1972, D.G.Y. & H. Fraiha. 5 ♂♂, 10 ♀♀, Belém (Para). flight traps, 30 July-6 Aug. 1974, D.G.Y. Ecuador. 1 ♂, Rio Napo at Limoncocha (Napo), flight trap, 22 May 1976, D.G.Y. & T. Rogers. Trinidad. 2+ ♂♂, 25+ ♀♀, various localities and dates.

*Discussion*: *Lutzomyia flaviscutellata* and its close allies, *L. olmeca olmeca* (Vargas & Díaz-Nájera) and *L. o. bicolor* form a distinct species complex. Both adults and immatures differ from other *Myssomyia* spp. as noted by Lewis (1975a,b) and Ward (1976). *Lutzomyia inornata* Martins, Falcão and da Silva, 1965, also may belong with them on the basis of the original description and figures. I have not examined specimens of this species.

In Colombia, *L. flaviscutellata* is probably restricted to lowland forests east of the Andes, the record of its presence in Valle Dept. (Barreto, 1969) being not that species but *L. olmeca bicolor*. We collected specimens of both species near Leticia and at Limoncocha,

Ecuador; thus lending additional support to the contention that the taxa are distinct (Fairchild & Theodor, 1971; Lewis, 1976b).

*Lutzomyia flaviscutellata* transmits *Leishmania mexicana amazonensis* Lainson and Shaw to small forest mammals and occasionally to man (Ward, 1977). Parasites referable to this subspecies have been recovered from wild flies in Brazil (Lainson & Shaw, 1968), Trinidad (Tikasingsh, 1975), and Venezuela (Pifano et al., 1973). This sand fly is also a vector of Pacui virus in Brazil (Aitken et al., 1975), a disease of small mammals.

Our knowledge of the bionomics of *flaviscutellata* has been gained largely through the efforts of Drs. R. Lainson, J. Shaw, and R. Ward, their papers being cited in the species bibliography. The Disney trap (Disney, 1966) or modifications of it have been effective in capturing large numbers of this and related species. The striking coloration of both sexes (Fairchild & Theodor, 1971) enables one to separate them from other *Lutzomyia* species without the aid of a microscope in areas in which *L. olmeca bicolor* does not also occur.

69. *Lutzomyia* (N.) *olmeca bicolor*  
(Fig. 56)

*Lutzomyia olmeca bicolor* Fairchild & Theodor, 1971: 157 (♂ holotype, Mojinga swamp, Canal Zone; ♀, Cruces Trail Canal Zone; also Colombian records). Christensen & Fairchild, 1971: 302 (Darién Prov., Panama). Chaniotis et al., 1971a: 344 et seq. (pop. dynamics, Panama). Chaniotis et al., 1971b: 415 et seq. (man biting study). Osorno et al., 1972a: 34-35 (Colombian records). Christensen 1972a: 88 (listed). Christensen et al., 1972: 55 et seq. (collecting data, Panama). Chaniotis et al., 1972: 95 (resting sites). Christensen & Herrero, 1973: 579 et seq.

(collecting data). Chaniotis, 1974b: 501 (keyed). Lewis, 1975b: 363 et seq. (taxonomy). Rutledge & Ellenwood, 1975a: 73 (breeding site, open forest floor). Herrer & Christensen, 1976a: 62 (collecting data, Panama). Ward, 1976: 238-239 (larva keyed, cf. to *flaviscutellata*).

*Phlebotomus apicalis* (not *apicalis* Floch & Abonnenc): Rodriguez, 1950: 6 (Ecuador). Rodriguez, 1956: 80 (Ecuador). Fairchild & Hertig, 1959: 121, 123 (in part, Panama only). Johnson & Hertig, 1961: 765 et seq. (rearing data). Thatcher, 1968a: 295 (hosts, Panama). Hanson, 1968: 46 et seq. (larva, pupa, descr., figs.).

*Lutzomyia flaviscutellata* (not *flaviscutellata* Mang.): Barreto, 1969: 464 (Valle, Colombia). Tesh et al., 1971a: 153 (blood meals). Osorno et al., 1972a: 34 (mention).

*Psychodopygus olmecus*: Forattini, 1973: 89 et seq. (gen. review, figs., disease relationships, refs.).

*Distribution*: Costa Rica, Panama, Colombia (Amazonas, Antioquia, Boyaca, Caqueta, Choco, Guajira, Magdalena, Norte de Santander, Santander, Tolima, Valle), Ecuador.

*Material examined*: Colombia. 3 ♂♂, 17 km W of Leticia (Amazonas), forest floor, 24 July 1973, D.G.Y. & R.C.W. 80 ♂♂, 22 ♀♀, Rio Anori (Antioquia), light & flight traps, biting man, May-June 1970, C.H.P. 17 ♂♂, 6 ♀♀, same data but light traps, tree buttress, Sept. 1970, D.G.Y. 1 ♂, Tres Esquinas (Caqueta), light trap, 10 Nov. 1971, C.J.M. 23 ♂♂, 102 ♀♀, Curiche (Choco), light, Shannon & Malaise traps, biting man, April-Dec. 1967, D.G.Y. 2 ♀♀, same locality, oil trap baited with *Agouti paca*, 25 April 1967, D.G.Y. 2 ♂♂, 16 ♀♀, Alto Curiche (Choco), light & Malaise traps, biting man, July-Dec. 1967, D.G.Y. 21 ♂♂, 42 ♀♀, Teresita (Choco), light, Shannon, oil, & Malaise traps, sweeping, biting



man, March-Dec. 1967, D.G.Y. 1 ♂, 4 ♀♀, Sautata (Choco), Malaise trap, tree buttress, Oct.-Nov. 1967, D.G.Y. 8 ♂♂, 2 ♀♀, Anchicaya Dam (Valle), light & flight traps, tree trunks, 9-11 Aug. 1973, D.G.Y. & R.C.W. *Costa Rica*. 2 ♂♂, 1 ♀, N of Marina, forest floor on dead leaves, 13 Feb. 1960, W. Hanson. 1 ♀, Turriabla, on horse, 2 May 1961, R. Rosabal. *Ecuador*. 2 ♂♂, Rio Napo at Limoncocha (Napo), light trap, 23-24 May 1976, D.G.Y. & T. Rogers. *Panama*. 8 ♂♂ (holotype and 7 paratypes), 25 ♀♀ paratypes, specific data given by Fairchild & Theodor (1971).

*Discussion:* Females of *olmeca bicolor*, like those of *L. flaviscutellata*, are not strongly anthropophilic. At Curiche, we captured only 9 ♀♀ on human bait from April to Dec., 1967 (141 man hours). We obtained similar results at Alto Curiche where a total of 8 ♀♀ were taken on man from 24 June to 18 Nov., 1967 (76 man hours). Only 1 female was collected on man at Teresita from 9 April to 16 Dec., 1967 (125 man hours).

Christensen et al. (1972) studied the bionomics of this subspecies at Sasardi, San Blas Territory, Panama. It was the most common sand fly on the forest floor and in rodent-baited Disney traps. *Leishmania mexicana* or close ally was recovered from numerous mammals there (Herrer et al., 1971) but was not detected in *olmeca bicolor* or other sand flies (Christensen et al., 1972).

70. *Lutzomyia* (N.) *trapidoi*  
(Fig. 57)

*Phlebotomus trapidoi* Fairchild & Hertig, 1952: 524 (♂ holotype, ♀, Almirante, Bocas del Toro Prov., Panama).

*Lutzomyia trapidoi*: Barretto, 1962: 98 (listed). Tesh et al., 1971a: 152 et seq. (blood meals). Tesh et al., 1971b: 491 et seq.

(virus transmission studies). Chaniotis et al., 1971a: 344 et seq. (pop. dynamics, Panama). Chaniotis et al., 1971b: 415 et seq. (man biting study). Christensen et al., 1971: 118 (pyloric spines). Christensen & Fairchild, 1971: 301 (Darién Prov., Panama). Osorno et al., 1972a: 35-36 (Colombian records). Tesh et al., 1972: 88 (blood meals). Chaniotis et al., 1972: 91 et seq. (resting sites). Christensen, 1972a: 68 (listed). Christensen et al., 1972: 55 et seq. (collecting data, Panama). Christensen & Herrero, 1973: 579 et seq. (collecting data, positive for Trypanosomatids). Chaniotis & Correa, 1974: 115 (collecting data). Chaniotis, 1974a: 73 et seq. (sugar feeding). Chaniotis, 1974b: 561 (keyed). Tesh et al., 1974: 258 et seq. (summary of virus studies). Chaniotis et al., 1974: 369 (dispersal study). Lewis et al., 1975a: 501 et seq. (mouthpart morphol.). Chaniotis, 1975: 183 et seq. (rearing data). Rutledge & Ellenwood, 1975a: 71 et seq. (breeding habitat, open forest floor, Panama), 1975b: 78 et seq. (ecology, breeding sites), 1976c: 83 (ecology, breeding sites). Christensen & Herrero, 1976: 299 et seq. (as host of *Endotrypanum*). Herrero & Christensen, 1976a: 57 (collecting data), 1976b: 62 et seq. (collecting data). Herrero et al., 1976: 70 (mention). Miles et al., 1976: 532 (mating aggregation). Zimmerman et al., 1977: 574 et seq. (egg, descr., figs.).

*Psychodopygus trapidoi*: Forattini, 1971a: 105 (listed). Forattini, 1973: 123 et seq. (gen. review, refs., figs.). Gomes, 1975: 9 et seq. (gen. review, distrib., ecology, biting habits).

*Distribution*: Honduras, Costa Rica, Panama, Colombia (Antioquia, Boyacá, Chocó, Tolima, Valle), Ecuador.

*Material examined*: Colombia. 35 ♂♂, 4 ♀♀, Rio Anorí (Antioquia), light traps, May 1970, C.H.P. 4 ♀♀, same data but Sept. 1970, D.G.Y.

74 ♂♂, 120 ♀♀, Curiche (Choco), light, Shannon & Malaise traps, tree trunks, biting man, May-Dec. 1967, D.G.Y. 5 ♂♂, 63 ♀♀, Alto Curiche (Choco), light Shannon traps, biting man, tree trunks, June-Dec. 1967, D.G.Y. 12 ♂♂, 61 ♀♀, Teresita (Choco), light, Malaise & Shannon traps, tree trunks, biting man, March-Dec. 1967, D.G.Y. 3 ♂♂, Rio Atrato at Sautata (Choco), Malaise trap, Jan. 1968, D.G.Y. 1 ♂, 8 ♀♀, Anchicaya Dam (Valle), light flight traps, tree trunks, 9-11 Aug. 1973, D.G.Y. & R.C.W. 52 ♂♂, 39 ♀♀, 25 km E of Buenaventura (Valle), light & flight traps, tree trunks, 11-12 Aug. 1973, D.G.Y. & R.C.W. *Costa Rica*. 4 ♀♀, Moravia, Chirripo (Cartago), Shannon trap, 4 March 1966, R. Zeledon. *Ecuador*. 84 ♂♂, 33 ♀♀, 17 km E of Santo Domingo de los Colorados (Pichincha), light & flight traps, tree trunks, May 1976, D.G.Y., T. Rogers, & G. Fairchild. *Honduras*. 3 ♀♀, Tela, Lancetilla Valley, light trap, 24 Feb. 1954, W. Hils. *Panama*. 1 ♂ (holotype no. 3291), type locality, 19 June 1951, A. Quinones & R. Hartmann. 1 ♀ (allotype no. 2474), Finca Nievocita, Almirante (Bocas del Toro), tree buttress, 21 June 1950, R. Hartmann. 100+ ♂♂, 100+ ♀♀, various localities, most of which were listed by Fairchild and Hertig (1952).

*Discussion:* Specimens of *L. trapidoi* from Valle Dept., Colombia and Pichincha Prov., Ecuador are darker than those from other localities, the heads and mesonota of both sexes being moderately infuscated. Structurally, however, they agree with the holotype and allotype of *trapidoi*.

I have cited only recent references to this species, Forattini (1973) having reviewed the important papers published prior to 1971.

At Curiche from April to Dec., 1967, we secured 52 ♀♀ of *trapidoi* in routine human bait collections. This represents 1.4% of the total catch

of 15 *Lutzomyia* spp. (3763 ♀♀, 141 man hours). At Teresita less than 1% of the biting sand flies captured during an eight month period represented this species. We did not attempt, however, to collect sand flies in the forest canopy where *trapidoid* is likely to be more abundant (Fairchild & Hertig, 1952; Chaniotis et al., 1971b).

During the day, *trapidoid* adults rest commonly on the forest floor, less frequently on living plants or on tree trunks (Chaniotis et al., 1972). The larvae live on the open forest floor (Rutledge & Ellenwood, 1975a,b,c) where they tend to be surface feeders (Hanson, 1968).

Flagellates, believed to be leishmanial promastigotes, were recovered from wild caught *trapidoid* females in Panama (Johnson et al., 1962; McConnell, 1963). This species may also play an important role in the epidemiology of certain arboviruses in that country, Tesh et al. (1974) having isolated a number of strains from males and females. There is presumptive evidence that vertical (transovarial) transmission of some viruses occurs in *L. trapidoid* and *L. ylephiletor* (Tesh & Chaniotis, 1975).

71. *Lutzomyia* (N.) *umbratilis*  
(Fig. 58)

*Lutzomyia umbratilis* Ward & Fraiha, 1977 (♀ holotype, Monte Dourado, Rio Jari, Para, Brazil).

*Phlebotomus intermedia* (not *intermedia* Lutz & Neiva, 1912): Floch & Abonnenc, 1941a: 2 (♂, descr., figs.). Floch & Abonnenc, 1942a: 9 (♀, descr., figs.).

*Phlebotomus anduzei* (not *anduzei* Rozeboom, 1942): Floch & Abonnenc, 1944c: 11 (♂, ♀, taxonomy, figs.). Floch & Abonnenc, 1945c: 4 (♀,

keyed, figs.). Floch & Abonnenc, 1947a: 18 (♂, keyed). Fairchild & Hertig, 1952: 523 et seq. (cf. to *ylephiletor* & *trapidoi*). Floch & Abonnenc, 1952: 37, 43 (♂, ♀, keyed), 121 (♂, ♀, redescr., figs.). Fairchild & Hertig, 1959: 121 (distrib., in part). Forattini, 1960: 476 (Amapa, Brazil). Wijers & Linger, 1966: 501 et seq. (Surinam, as probable vector of *Leishmania*).

*Lutzomyia anduzei* (not *anduzei* Rozeboom, 1942): Martins et al., 1963: 334 (Roraima, Brazil). Martins et al., 1965 (Rondonia & other Brazilian localities). Almeida, 1970a: 2 et seq. (anomalous ♂, figs.), 1970b: 1 et seq. (♂, ♀, redescr., figs.). Christensen, 1972a: 88 (listed, Panama). Osorno et al., 1972a: 76 (Colombian records). Llanos, 1973, 33 (♂, ♀, redescr., figs., Peru). Lewis, 1975a: 501 et seq. (mouthpart morphol.). Llanos et al., 1975b: 669 (Peru). Martins et al., 1976a: 487 (Peru). Lainson et al., 1976: 171-172 (as vector of *Leishmania* in northern Brazil). Ward, 1977: 228 et seq. (larva descr., fig., keyed). Lainson et al., 1977 (Mato Grosso, Brazil).

*Lutzomyia* sp. no. 260.31 Ward et al., 1973: 178 (collecting data, Para, Brazil). Ward & Killick-Kendrick, 1974: 216, 219 (Para, Brazil).

*Psychodopygus anduzei*: Forattini, 1973: 388 et seq. (in part, gen. review, figs., refs.).

*Distribution*: Colombia (Amazonas, ?Boyaca, ?Caqueta), Peru, Brazil, Surinam, French Guiana.

*Material examined*: Colombia. 6 ♂♂, 1 ♀, 17 km W of Leticia (Amazonas), tree trunks, 24-26 July 1973, D.G.Y. & R.C.W. Brazil. 15 ♂♂, 10 ♀♀, Serra do Navio (Amapa), tree trunks, 21 Sept. 1972, D.G.Y. & H. Fraiha. 1 ♂, Rio Aripuana at Humboldt (Mato Grosso), tree trunk, 16 Aug. 1974, D.G.Y. & J. Shaw. 1 ♀, 27 km SE of Maraba (Para), light trap,

26-28 Sept. 1972, D.G.Y. & H. Fraiha. 1 ♂, near Altamira (Para), tree trunk, 1 Oct. 1972, D.G.Y.

*Discussion:* *Lutzomyia umbratilis*, confused with *L. anduzei* (Rozeboom) for many years, differs from it by the darker mesonotum, by the striated sperm ducts (smooth walled in *anduzei*), by the relative lengths of palpal segments 2 and 5, and by other features discussed by Ward & Fraiha (1977). The male of *anduzei* has not been described.

Fairchild & Hertig (1959) reported the presence of *L. anduzei* in Costa Rica and Panama. I have not examined Costa Rican specimens but 3 ♀♀ from Almirante (Bocas del Toro Prov., 19-21 June 1950, R. Hartmann) seem to be conspecific with *L. anduzei* (Rozeboom). The fifth palpal segment is shorter than the third, most of the insect is pale and the spermathecae and ducts are similar to those of *L. anduzei* Rozeboom except for some transverse striations on the individual ducts.

There is no doubt that the specimens from near Leticia, Colombia, are conspecific with *L. umbratilis* as described by Floch & Abonnenc (1944, 1952, as *anduzei*) and by Ward & Fraiha (1977). I am assuming, perhaps incorrectly, that the records of *anduzei* by Osorno et al. (1972a) from Boyaca and Caqueta Departments represent *L. umbratilis*, not *anduzei* Rozeboom.

Lainson et al. (1976) found promastigotes in 4 out of 55 *umbratilis* females examined in northern Brazil. These subsequently proved to belong in the genus *Leishmania* and may be identical to the type discussed by Wijers & Linger (1966) in Surinam (Lainson et al., op. cit.).

72. *Lutzomyia* (N.) *ylephiletor*  
(Fig. 59)

*Phlebotomus ylephiletor* Fairchild & Hertig, 1952: 518 (♂ holotype, Almirante, Bocas del Toro Prov., Panama; ♀, Cacique, Colon Prov., Panama). Lewis & Garnham, 1959: 82 (Belize). Fairchild & Hertig, 1959: 122 (distrib.). Forattini, 1960: 474 (not *ylephiletor* Fairchild & Hertig, 1952). Hanson, 1961: 320 et seq. (larvae on forest floor). Johnson & Hertig, 1961: 765 (rearing data). Hanson, 1968: 95 (larva, pupa, figs.).

*Lutzomyia ylephiletor* (or *ylephiletria*): Barretto, 1962: 98 (listed). Barreto, 1969: 468 (Valle, Colombia). Williams, 1970: 332 et seq. (summary of collecting data, Belize). Tesh et al., 1971a: 152 et seq. (blood meals). Chaniotis et al., 1971a: 344 et seq. (pop. dynamics, Panama). Chaniotis et al., 1971b: 415 et seq. (man-biting study). Osorno et al., 1972a: 36 (listed). Tesh et al., 1972: 88 et seq. (blood meals). Chaniotis et al., 1972: 91 et seq. (resting sites). Christensen, 1972a: 88 (listed). Christensen et al., 1972: 55 et seq. (collecting data). Zeledon & Alfaro, 1973: 416 (naturally infected with *Leishmania*, Costa Rica). Christensen & Herrer, 1973: 579 et seq. (collecting data, Panama). Chaniotis, 1974a: 73 et seq. (sugar feeding tests). Chaniotis & Correa, 1974: 115 (collecting data). Chaniotis, 1974b: 501 (keyed). Tesh et al., 1974: 258 et seq. (summary of virus studies). Chaniotis et al., 1974: 372 et seq. (dispersal study). Lewis, 1975a: 501 et seq. (mouthpart morphol.). Lewis, 1975b: 366 (hair sockets, figs.). Tesh & Chaniotis, 1975: 125 et seq. (virus transmission studies). Herrer & Christensen, 1976a: 62 (collecting data), 1976b: 57 (collecting data). Williams, 1976a: 604 (in caves, Belize). Zimmerman et al., 1977: 574 et seq. (egg, descr., figs.).

*Psychodopygus ylephiletor*: Forattini, 1971a: 106 (listed).

Forattini, 1973: 123 et seq. (gen. review, refs., figs.). Gomes, 1975: 9 et seq. (gen. review, distrib.).

*Distribution*: Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Colombia (Choco, Valle).

*Material examined*: Colombia. 17 ♀♀, Curiche (Choco), Shannon & Malaise traps, biting man, tree trunks, 26 June-25 Nov. 1967, D.G.Y. Mexico. 1 ♀, Palenque (Chiapas), tree buttress, 1 April 1951, G. Fairchild & R. Hartmann. 2 ♀♀, Teapa (Tabasco), light traps, 19 Aug. & 10 Sept. 1953. Guatemala. 8 ♀♀, Montana del Mico, Rio Blanco, human bait, no data (but probably March 1956), J. Boshell. Honduras. 19 ♀♀, Tela, Lancetilla Valley, human bait, March-April, 1954, W. Hils. Nicaragua. 1 ♂, 1 ♀, Villa Somoza, 15 June 1953. Costa Rica. 2 ♀♀, Esquinas (Puntarenas), tree buttresses, 28 Nov. 1949, H. Trapido. Panama. 1 ♂ (holotype no. 2448), type locality, tree buttress, 17 June 1950, R. Hartmann. 1 ♀ (allotype no. 1690), Cacique (Colon), tree buttress, 17 Sept. 1949, R. Hartmann. 12 ♂♂, 11 ♀♀, Almirante (Bocas del Toro), tree buttresses, 12 Aug. 1951, A. Quinones.

*Discussion*: Where collected in Colombia, this species appears to be less common than its close ally, *L. trapidoi*. Adults and immatures are very similar in structure, Fairchild & Hertig (1952) pointing out differences between the adults, Hanson (1968) distinguishing the immatures.

Most of the information on the bionomics of *L. ylephiletor* has been acquired by investigators working in Panama. Tesh et al. (1971a) noted that adult females have a broad host range, their blood meals reacting mainly with 7 mammalian order-specific antisera, the percentages of each varying with locality and season. Human bait collections during a one



year period revealed that most *ylephiletor* females bite in the forest canopy (Chaniotis et al., 1971b). Adults tend to rest on tree trunks (Chaniotis et al., 1972).

Leishmanial promastigotes were recovered from wild females in Panama (McConnell, 1963) and Costa Rica (Zeledon & Alfaro, 1973). Adults have been found naturally infected with certain arboviruses in Panama (Tesh et al., 1974), some of which may be transovarially transmitted.

73. *Lutzomyia* (N.) *yuilli*  
(Fig. 60)

*Lutzomyia yuilli* Young & Porter, 1972: 524 (♂ holotype, ♀, Rio Anori, Antioquia Dept., Colombia). Osorno et al., 1972a: 79 (listed). Ward & Ready, 1975: 128 et seq. (egg descr., fig.). Lewis, 1975a: 501 (mouthpart morphol., fig., Colombia & Brazil). Llanos et al., 1975b: 671 (listed, Peru). Martins et al., 1976a: 488 (Peru). Lainson et al., 1977 (infected with epimastigote flagellates, Mato Grosso, Brazil). Zimmerman et al., 1977: 575 (egg cf. to that of *ylephiletor*). Fraiha et al., 1978 (collecting data, Brazil).

?*Lutzomia intermedia*: Osorno et al., 1972a: 34 (not *intermedia* Lutz & Neiva, 1912).

*Lutzomyia* sp., near *intermedia* Shaw et al., 1972: 720 (biting man, Para, Brazil).

*Lutzomyia antunesi*: Llanos, 1973: 33 (in part, ♀ not *antunesi* Coutinho, figs., redescri.).

*Psychodopygus yuilli*: Gomes, 1975: 9 (listed).

*Distribution*: Colombia (Antioquia, Caqueta, Meta), Ecuador, Peru, Brazil, Surinam.

*Material examined:* Colombia. 1 ♂ (holotype no. 163), type locality, light trap, 14 May 1970, C.H.P. 1 ♀ (allotype no. 168), same data but 23 May 1970. 224 ♂♂, 244 ♀♀ (including paratypes), same locality, May & Sept. 1970, C.H.P. & D.G.Y. 2 ♀♀, Tres Esquinas (Caqueta), light trap, 10 Nov. 1971, C.J.M. Brazil. 5 ♀♀, Belem (Para), biting man, 28 Oct. 1970, J. Shaw et al. Ecuador. 3 ♂♂, 15 ♀♀, Rio Napo at Limoncocha (Napo), light & flight traps, 19-23 May 1976, D.G.Y. & T. Rogers.

*Discussion:* In addition to these specimens, I examined a female (INPES no. 269) from San Martin (Meta), Colombia, reported as *L. intermedia* by Morales et al. (1969a) and Osorno et al. (1972a). The specimen is definitely not conspecific with *intermedia* Lutz & Neiva but appears to be *L. yuilli* although the sperm ducts are nearly invisible due to mounting.

*Lutzomyia* sp. de Souvenir Floch & Abonnenc (= *Psychodopygus* (*Trichophoromyia*) sp. of Forattini, 1973) is uncomfortably close to *L. yuilli* and may be conspecific with it but I have not examined females from French Guiana or Amapa Territory, Brazil. The male of sp. de Souvenir remains unknown.

Dr. Donald M. Minter informed me (in litt.) that he has collected *L. yuilli* in Surinam.

Figure 55

*Eutzomyia (N.) antunesi* -- A. Male genitalia, B. Female cibarium,  
C. Spermathecae.

Male: Trinidad

Female: Trinidad

*Eutzomyia (N.) flaviscutellata* -- D. Spermathecae, E. Genital pump and  
genitalia, F. Female cibarium.

Male: Leticia, Amazonas Comisaria, Colombia

Female: Trinidad

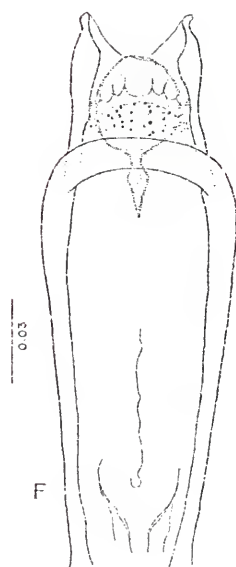
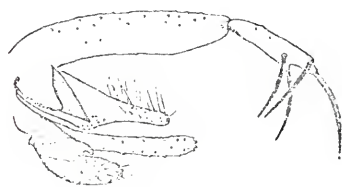
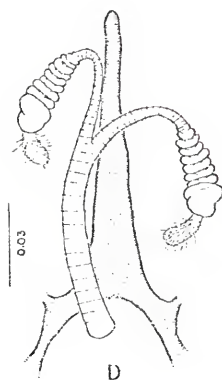
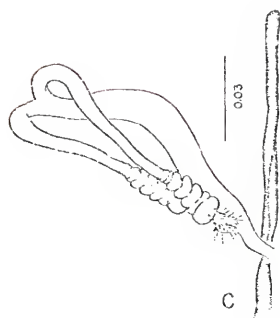
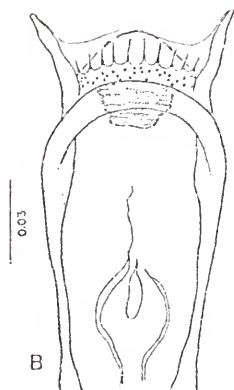
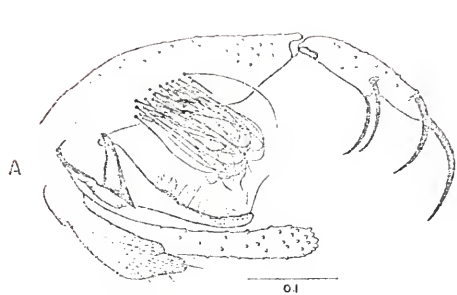


Figure 56

*Lutzomyia (N.) olmeca bicolor* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium, F. Male genitalia, G. Genital pump and filaments, H. Spermathecae, I. Female wing, J. Male wing, K. Female wing.

Male: Curiche, Choco Dept., Colombia

Female: Same locality as male

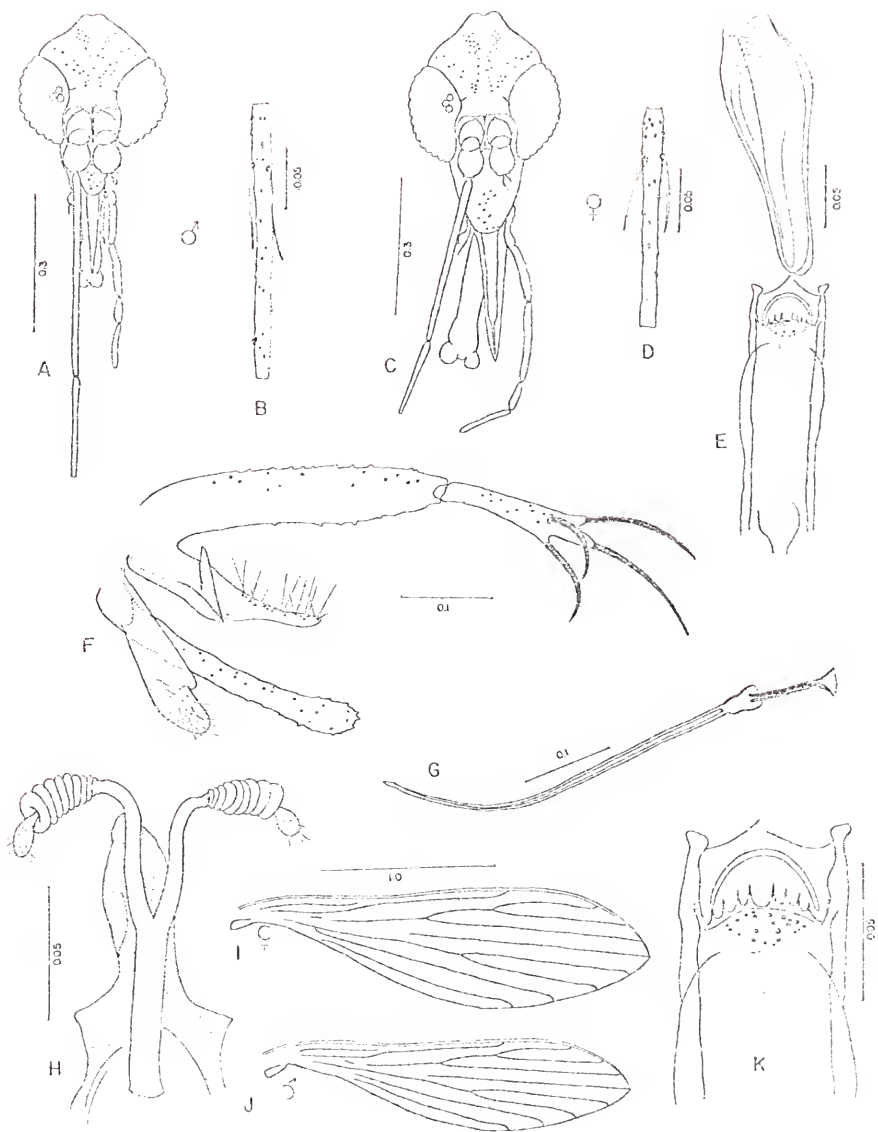


Figure 57

*Lutzomyia (N.) trapidoi* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, G. Genital pump and filaments, H. Spermathecae, I. Female wing, J. Male wing, K. Female cibarium.

Male: Curiche, Choco Dept., Colombia

Female: Same locality as male

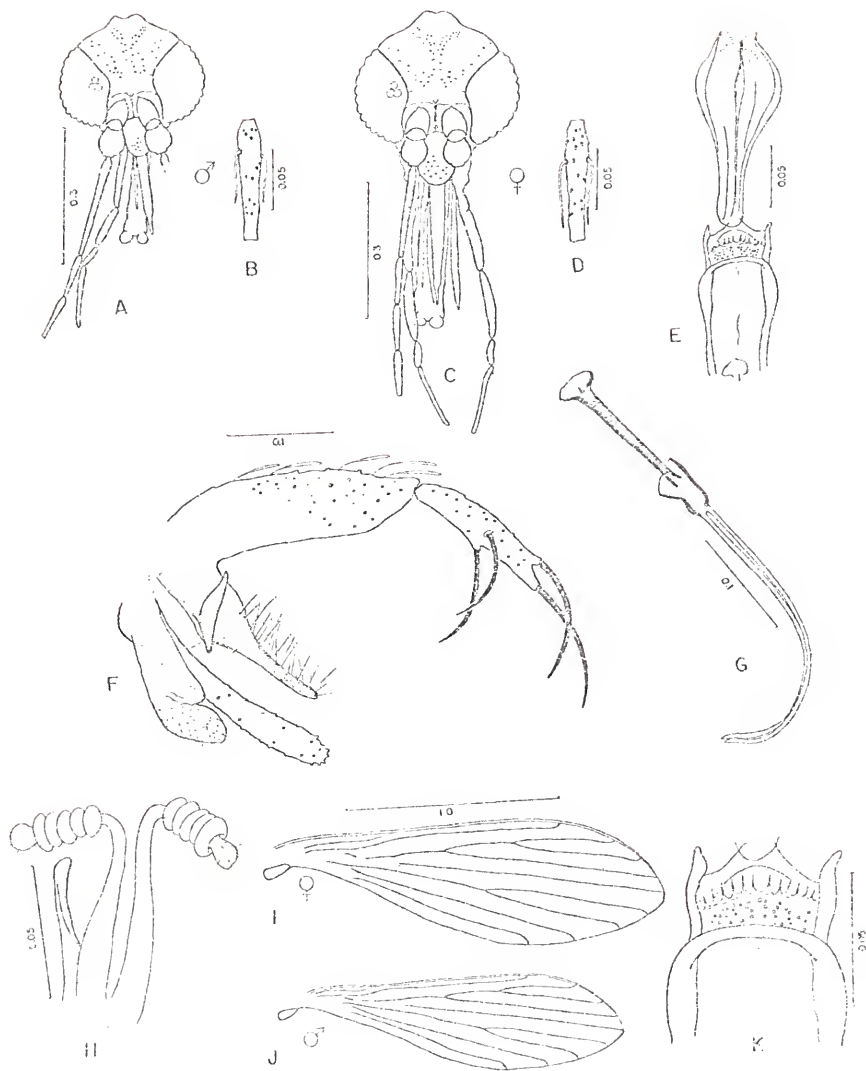




Figure 58

*Lutzomyia (N.) umbratilis* -- A. Male head, B. Female head, C. Female cibarium, D. Female wing, E. Male genitalia including genital pump, F. Tip of genital filament, G. Spermathecae.

Male: Leticia, Amazonas Comisaria, Colombia

Female: Para State, Brazil

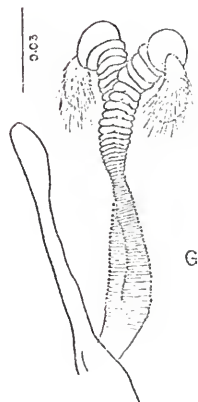
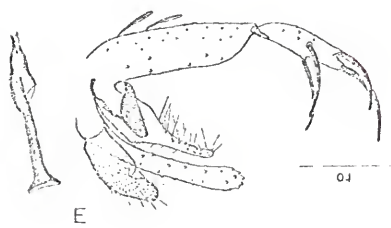
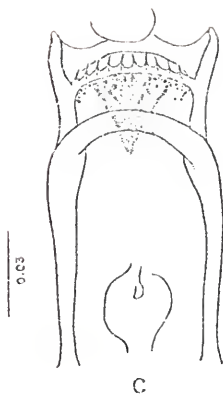
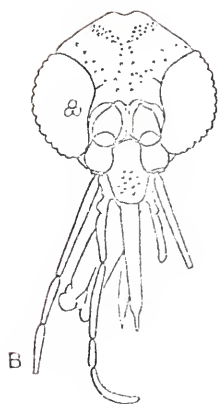
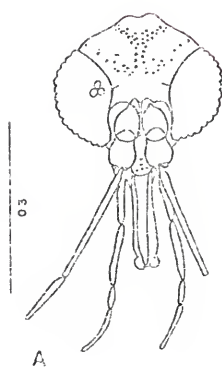
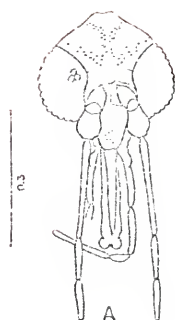


Figure 59

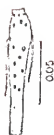
*Lutzomyia (N.) ylephiletor* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, G. Spermathecae of female from Costa Rica, H. Female wing, I. Male wing, J. Female cibarium.

Male: Almirante, Bocas del Toro Prov., Panama

Female: Panama Canal Zone (except Fig. 59G)



♂



B



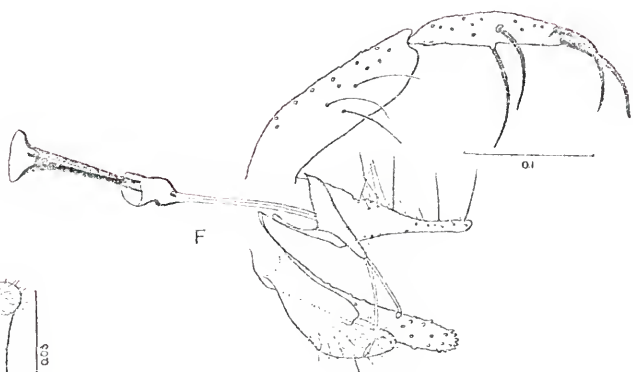
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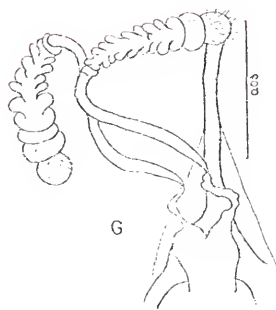
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F



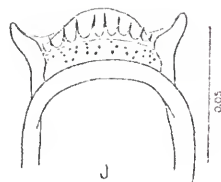
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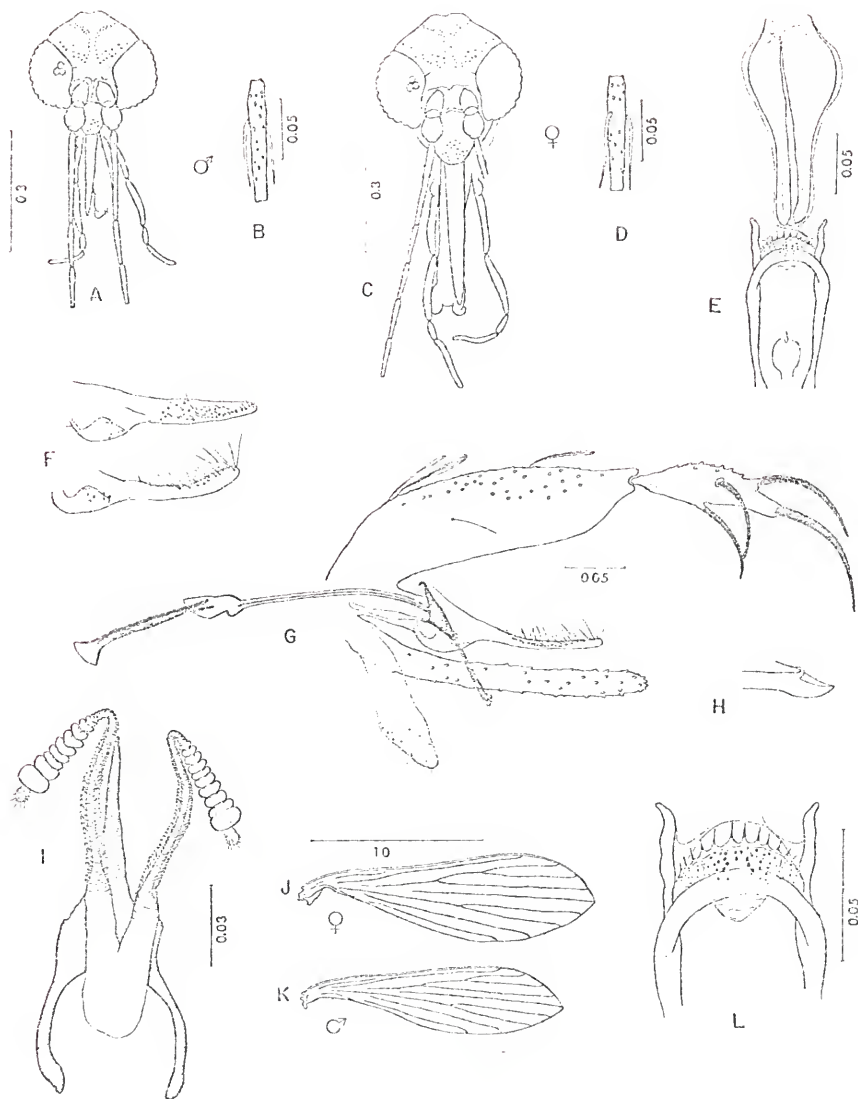
J

Figure 60

*Lutzomyia (N.) yuilli* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Different views of paramere, G. Male genitalia, H. Tip of genital filament, I. Spermathecae, J. Female wing, K. Male wing, L. Female cibarium (all figures from Young & Porter, 1972).

Male: Rio Anori, Antioquia Dept., Colombia

Female: Same locality as male



Subgenus *Psychodopygus* Mangabeira, 1941

Some of the most notorious man-biters among the *Lutzomyia* sand flies belong in this subgenus, a well defined group of about 25 taxa which is sometimes treated as a genus (Forattini, 1971a, 1973). Members of *Psychodopygus* range from Mexico to southern Brazil and are commonly observed in forests attacking man. Several species have been incriminated as vectors of dermal leishmaniasis caused by *Leishmania braziliensis* (Lainson et al., 1973).

Many of the species were described originally from a single sex from a single locality (nondimensional species) and this, along with the difficulty of identifying females alone, has led to numerous errors in the taxonomic and medical literature. Some corrections and name changes, discussed in more detail under the species, are summarized as follows.

*Lutzomyia tintinnabula* Christensen and Fairchild, is a junior synonym of *L. ayrozai* (Barretto and Coutinho) (NEW SYNONYM). *Lutzomyia pessoana* (Barretto) from southern Brazil is a junior synonym of *L. carrerai* (Barretto) described from Meta Dept., Colombia. *Lutzomyia pessoana* of various authors, treated as *Phlebotomus paraensis* by Fairchild and Hertig, 1951a, differs subspecifically from *L. carrerai* and is given a new name, *L. carrerai thula* n. ssp. The female of *L. c. carrerai* (NEW STATUS) or possibly that of *L. fairchildi* Barretto was incorrectly described as *L. davisii* by Root (1934). Martins et al., (1973b) and Llanos (1973) correctly associated the sexes of *L. davisii*. Forattini's descriptions (1960, 1973) of the female of *L. paraensis* (Costa Lima) represent not that species but *L. davisii*.

*Lutzomyia hirsuta* (Mang.) and *L. nicaraguensis* (Fairchild and Hertig) differ subspecifically (NEW STATUS). The female of *L. h. hirsuta*, was

incorrectly described as *L. davisii* (not *davisii* Root, 1934), by Forattini (1960, 1973). Only the nominate subspecies occurs in Colombia where it was misidentified as *L. paraensis* by Osorno et al. (1972a).

The other records of *paraensis* in Colombia (Barreto, 1969) represent not that species but *L. carrerai thula* and/or *L. ayrozai*. Antunes (1937) reported the presence of *L. squamiventris* (Lutz and Neiva) in Meta Dept., Colombia but this record is based on females alone and I consider it to be doubtful, believing that the specimens represented another species in the series *squamiventris*, probably *L. fairtigi* Martins.

Based on male genitalia, the *Psychodopygus* species are divided into 3 series following Theodor (1965) and Lewis et al. (1978). This agreement, admittedly artificial, is useful nevertheless for discussion and identification purposes. The short fifth palpal segment and imbricated spermathecae, both apomorphic features, are characteristic of all the *Psychodopygus* species. Studies on feeding habits indicate that most, if not all, females feed on mammals. The male genitalia may be simple (series *arthuri*) or very complex (series *squamiventris* and *paramensis*).

At present, 14 species and subspecies in the subgenus are known to occur in Colombia.

### Keys to Species

#### Males

##### *Series squamiventris*

1. Paramere as shown, with dense apical patch of 30+ long erect setae and with a slender upwardly directed process at apex. . *chagasi* (Fig. 61)
- Paramere otherwise, without dense patch of dorsal setae but with a group of 5-20 setae near base of subterminal dorsal arm. . . . . 2



2. Main lobe of paramere slender and upturned apically, with a group of about 15 long setae near base of dorsal arm . . . *bernalesi* (Fig. 61)
- Main lobe of paramere broad, not upturned apically, with about 5 short stout setae near base of dorsal arm . . . . . *fairtigi* (Fig. 62)

Series *arthuri*

The male of *L. bispinosa*, the sole representative of this series in Colombia, differs from other *Psychodopygus* males by having only 2 spines on the style, both of which are terminal.

Series *panamensis*

1. Style with 5 (rarely 6) strong spines. Paramere as figured . . . .  
. . . . . *davisi* (Fig. 67)
- Style with 3 strong spines and 1 smaller bristle. Paramere otherwise. . . . . 2
2. Paramere simple, slender distally, without arms or other extensions  
. . . . . *guyanensis* (Fig. 68)
- Paramere complex, with ventral and/or dorsal arm. . . . . 3
3. Paramere with recurved apical setae on main lobe and ventral arm; dorsal arm present. Aedeagus long and slender, reaching to ends of longest recurved setae on main lobe of paramere . . *recurva* (Fig. 71)
- Paramere otherwise, without dorsal arm or recurved setae. Aedeagus rather short and stout. . . . . 4

4. Main lobe of paramere with 2 tufts of blade-like setae; ventral arm with 2 enlarged setae, one terminal and one subterminal . . . . .  
 . . . . . *panamensis* (Fig. 70)
- Main lobe of paramere with 1 group of setae, blade-like or not; ventral arm with smaller, more numerous setae. . . . . 5
5. Paramere as shown, ventral arm inserted near base of main lobe. . .  
 . . . . . *hirsuta hirsuta* (Fig. 67)
- Paramere otherwise, ventral arm shorter, inserted at or near apex of main lobe . . . . . 6
6. Mesonotum and pleura pale . . . . . *carrerei carrerei* (Fig. 65)  
*carrerei thula* (Fig. 66)
- Mesonotum partly or entirely pigmented, contrasting with pale pleura\*  
 . . . . . 7
7. Paramere with a short ventral arm (length subequal to width of coxite); apical setae (20+) shorter, not blade-like. Mesonotum, katapisternum, procoxae, and mesocoxae pigmented . . . . . *ayrozai* (Fig. 64)
- Paramere with a longer ventral arm, its length definitely greater than width of coxite; apical setae (less than 20) blade-like and long. Only mesonotum pigmented. . . . . *nocticola* (Fig. 69)

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\*The katapisternum of *L. ayrozai* is faintly pigmented but the rest of the pleura is decidedly paler than the mesonotum.

Females:

1. Common sperm duct completely smooth-walled, not rugose\* . . . . .  
. . . . . *bernalesi*  
*chagasi*  
*fairtigi* (Fig. 62)
  
- Common sperm duct rugose in part and/or with transverse striations. 2
  
2. Cibarium with small subequal vertical teeth in 1-3 transverse rows,  
without longitudinal rows . . . . . *recurva* (Fig. 71)
  
- Cibarium with vertical teeth of varying size, those in the middle  
enlarged and forming 2 or more longitudinal rows, irregular or not. 3
  
3. Spermatheca shorter than individual duct. . . . . 4
  
- Spermatheca longer than individual duct . . . . . 5
  
4. Common sperm duct with complete transverse striations . . . . .  
. . . . . *guyanensis* (Fig. 68)
  
- Common sperm duct with incomplete transverse striations appearing as  
short, thick lines. . . . . sp. of Tres Esquinas (Fig. 61)
  
5. Mesonotum and pleura pale . . . . . 6
  
- Mesonotum partly or entirely pigmented, contrasting with pale  
pleura. . . . . 7

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\*I am not able to separate these females without associated males. The female of *L. bernaleti*, presently unknown, probably resembles the other 2 species, all of which belong in the series *squamiventris*.

6. Labrum shorter than 0.30 mm or shorter than combined length of scape and flagellomere I. . . . . *carrerei carrerei* (Fig. 65)  
  
Labrum longer than 0.30 mm or greater than combined length of scape and flagellomere I. . . . . *carrerei thula* (Fig. 66)
7. Cibarium with short inwardly directed horizontal teeth. Katepisternum, procoxae, and mesocoxae pigmented . . . . . *ayrosai* (Fig. 64)  
  
Cibarium with longer erect horizontal teeth. Katepisternum, procoxae, and mesocoxae pale. . . . . 8
8. Common sperm duct completely smooth-walled below rugose portion . . 9  
  
Common sperm duct with transverse striations or dot-like thickenings below rugose portion. . . . . 10
9. Terminal annulation of spermatheca asymmetrical. Mesoscutellum pigmented. . . . . *panamensis* (Fig. 70)  
  
Terminal annulation of spermatheca symmetrical. Mesoscutellum pale . . . . . *nocticola* (Fig. 69)
10. Common sperm duct with complete or nearly complete transverse striations. Stem of genital fork broad, blade-like . . *bispinosa* (Fig. 63)  
  
Common sperm duct heavily rugose below junction of individual ducts; rest of duct with dot-like thickenings, not transversely striated. Stem of genital fork more slender, subacute at tip. . . . . 11
11. Individual sperm duct less than half the length of spermatheca; rugose section of common duct swollen near junction of individual ducts. . . . . *hirsuta hirsuta* (Fig. 67)

Individual sperm duct over half the length of spermatheca; rugose section of common duct not swollen, more or less equal in width throughout. . . . . *davisi* (Fig. 67)

Series *squamiventris*

74. *Lutzomyia* (P.) *bernalei*  
(Fig. 61)

*Phlebotomus bernalei* Osorno, Morales, & Osorno, 1967: 30 (♂ holotype, Araracuara, Caqueta, Colombia).

*Lutzomyia bernalei*: Martins et al., 1968: 22 (mention). Osorno et al., 1972a: 45 (listed).

*Psychodopygus bernalei*: Forattini, 1971a: 104 (listed). Forattini, 1973: 392 et seq. (review, keyed, fig.).

*Distribution*: Colombia (Caqueta).

*Material examined*: ♂ holotype (INPES no. 129), type locality.

*Discussion*: This species, identified by the characters in the key, is known from only two males, the holotype which I briefly examined at INPES, Bogota, and a paratype from the type locality. Both were captured in a tree hole.

75. *Lutzomyia* (P.) *chagasi*  
(Fig. 61)

*Phlebotomus chagasi* Costa Lima, 1941: 6 et seq. (♀ holotype, Rio Negro, Amazonas, Brazil).

*Phlebotomus unisetosus* Managabeira, 1941a: 238 (♂, Piratuba, Abaete, Para, Brazil). Barretto, 1951: 225 (distrib.). Osorno et al., 1967: 29 (Caqueta, Colombia).

*Lutzomyia unisetosa*: Barretto, 1962, 94 (listed). Barretto, 1966: 141 (keyed). Martins et al., 1968: 1 et seq. (as synonym of *chagasi*). Llanos, 1973: 31 (♂, ♀, redescr., figs., Peru).

*Lutzomyia chagasi*: Barretto, 1962: 94 (listed). Theodor, 1965: 188 (♂ fig.). Martins et al., 1968: 1 et seq. (♀, redescr., figs., refs.).

*Psychodopygus unisetosus*: Forattini, 1971a: 104-105 (listed).

*Psychodopygus chagasi*: Forattini, 1973: 392 et seq. (review, keyed). Fraiha et al., 1974: 89 (♂, figs., biting man).

*Distribution*: Colombia (Caqueta),

*Material examined*: Colombia. 4 ♂♂, Tres Esquinas (Caqueta), light trap, 10 Nov. 1971, C.J.M. Brazil. 1 ♀, km 13 Macajai-Caracarai (Roraima), human bait, 16 July 1973, H. Fraiha.

*Discussion*: This man-biting species, precinctive in the Amazon Basin, is easily recognized but I am unable to separate the females from those of *L. fairtigi*, *L. squamiventris*, and related species in the series *squamiventris* without associated males.

76. *Lutzomyia* (P.) *fairtigi*  
(Fig. 62)

*Lutzomyia fairtigi* Martins, 1970: 279 (♂ holotype, Villavicencio, Meta Dept., Colombia). Martins & Morales, 1972: 366 (listed).

*Phlebotomus squamiventris*: Fairchild & Hertig, 1951a: 414 (♂, ♀, redescr., figs., not *squamiventris* Lutz & Neiva, 1912).

*Psychodopygus fairtigi*: Fraiha et al., 1971: 495-496 (cf. to *wellectnei*). Forattini, 1971b: 152-154 (Mato Grosso, Brazil). Forattini, 1973: 392 et seq. (distrib., figs., keyed).

*Distribution:* Colombia (Meta, Caqueta), ?Brazil (Mato Grosso).

*Material examined:* Colombia. ♂ holotype, ♀ allotype, 6 ♀♀ paratypes, Villavicencia (Meta), stable trap, 10 June 1948, C.Y. Chow. 3 ♂♂, Tres Esquinas (Caqueta), light trap, 10 Nov. 1971, C.J.M.

*Discussion:* A little known species, *L. fairtigi* was first collected in a donkey-baited stable trap at Villavicencio and later in a light trap at Tres Esquinas. Forattini (1971b, 1973) lists this species (females only) from Salto Augusto (Mato Grosso), Brazil, but its presence there can only be confirmed when the male is discovered.

Series *arthurii*

77. *Lutzomyia* (P.) *bispinosa*  
(Fig. 63)

*Phlebotomus bispinosus* Fairchild & Hertig, 1951a: 410 (♂ holotype, La Victoria, Cerro Jefe, Panama). Fairchild, 1955: 194 (listed). Lewis & Garnham, 1959: 80-81 (♀ figs., Belize). Fairchild & Hertig, 1959: 121, 123 (distrib., Central America). Forattini, 1960: 479 (Amapa, Brazil). Williams et al., 1965: 65 et seq. (Belize).

*Lutzomyia bispinosa*: Barretto, 1962: 94 (listed). Theodor, 1965: 188 (listed). Barretto, 1966: 141, 144 (keyed). Williams, 1970: 332 et seq. (Belize). Chaniotis et al., 1971a: 344-345 (collecting data, Panama). Christensen, 1972a: 88 (listed). Lewis, 1975a: 500 et seq. (mouthpart morphol.). Lainson et al., 1977 (Mato Grosso, Brazil).

*Psychodopygus bispinosus*: Forattini, 1971a: 104 (listed). Forattini, 1973: 170 et seq. (distrib., ♂, ♀, keyed, figs.).

*Distribution:* Belize, Honduras, Nicaragua, Panama, Colombia (Choco), Ecuador, Northern Brazil.

*Material examined:* *Colombia.* 24 ♀♀, Curiche (Choco), biting man, tree trunk, Malaise, light, & Shannon traps, May-Oct. 1967, D.G.Y. 1 ♀, Alto Curiche (Choco), light trap, 8 Sept. 1967, D.G.Y. 10 ♂♂, 66 ♀♀, Teresita (Choco), biting man, tree trunks, in Malaise, light, & Shannon traps, May-Dec 1967, D.G.Y. *Ecuador.* 3 ♀♀, Rio Napo at Limoncocha (Napo), flight trap, 22-24 May 1976, D.G.Y. & T.E. Rogers. *Panama.* ♂ holotype, La Victoria, Cerro Jefe (Panama Prov.), at light, 29 Aug. 1950. M. Hertig & P. Galindo. ♀ allotype, same data as holotype. *Honduras.* 6 ♀♀, Lancetilla Valley, Tela, light traps, Sept.-Dec. 1953, W. Hils. *Panama.* 1 ♀, Rio Paya (Darién Prov.), Shannon trap, 7 July 1958, P. Galindo & A. Quinones.

*Discussion:* *Lutzomyia bispinosa*, reported here for the first time in Colombia, was captured in moderate numbers at Curiche and Teresita in the Choco. At the latter site, a total of 588 females of 6 *Lutzomyia* species were taken on human bait from April 1967 to 16 Dec. 1967 (125 man hours). *Lutzomyia bispinosa* accounted for 19 of these.

Other than biting man, the habits of this species are poorly known. Williams (1970) infrequently collected specimens in tree buttresses and under leaves on the forest floor in Belize.

*Series panamensis*

78. *Lutzomyia* (P.) *ayrozai*  
(Fig. 64)

*Phlebotomus ayrozai* Barretto & Coutinho, 1940: 131 (♂ holotype, Horto Florestal da Cantareira, Sao Paulo (Sao Paulo) Brazil). Barretto & Coutinho, 1943: 183 (♀ descr., not *ayrozai* Barretto & Coutinho). Barretto, 1947: 188 (refs.). Abonnenc, 1948: 1 (French Guiana).



Fairchild & Hertig, 1951a: 401-404 (listed, keyed). Barretto, 1951: 212 (describ.). Forattini, 1960: 471 et seq. (mention). Ortiz & Alvarez, 1972: 140, 143 (listed). Ortiz, 1972b: 222 et seq. (in part, taxonomic discussion, keyed, figs.).

*Phlebotomus davisii*: Coutinho, 1939: 181 (♀, not *davisii* Root, 1934).

*Sergentomyia ayrozai*: Barretto, 1955b: 249 (cf. to *pessoana*).

Barretto & Zago, 1956: 178-179 (Petropolis, Brazil).

*Lutzomyia ayrozai*: Barretto, 1962: 94 (listed). Barretto, 1966: 140 et seq. (in part, keyed). Barretto, 1969: 463 (Valle, Colombia). Osorno et al., 1972a: 45 (mention). Young, 1973: 108, 111 (mention).

*Lutzomyia amazonensis*: Aitken et al., 1968: 254 (Trinidad, not *amazonensis* Root, 1934).

*Lutzomyia tintinnabula* Christensen & Fairchild, 1971: 301 (♂, ♀, Darien Prov., Panama). Osorno et al., 1972a: 48 (Caqueta, Colombia). Young, 1973: 108, 111 (mention). Lewis, 1975a: 502 et seq. (mouthpart morphol., keyed, Para, Brazil). *NEW SYNONYM.*

*Psychodopygus ayrozai*: Forattini, 1971a: 104 (listed). Forattini, 1973: 392 et seq. (in part, distrib., figs., keyed, taxonomy). Gomes, 1975: 9 (listed). Forattini & Galati, 1977: 25 (♀, figs., discussion).

*Phlebotomus tintinnabulus*: Ortiz & Alvarez, 1972: 140 et seq. (listed). Ortiz, 1972b: 222 et seq. (taxonomy, discussion).

*Lutzomyia* "Tuture sp." Lewis, 1975a: 502 et seq. (mouthpart morphol., sensilla, keyed, Trinidad).

*Psychodopygus tintinnabula*: Gomes, 1975: 9 (listed). Ward, 1976: 239 (mention).

*Distribution*: Colombia (Antioquia, Boyaca, Caqueta, Choco, Valle), Trinidad, French Guiana, Brazil, Panama.

*Material examined:* Colombia. 225 ♂♂, 246 ♀♀, Rio Anori (Antioquia), light traps, May 1970, C.H.P. 1 ♂, 4 ♀♀, same data but flight trap, 3 May 1970. 2 ♀♀, same data but biting man, 25 June 1970. 107 ♂♂, 204 ♀♀, same data but light traps, Sept. 1970, D.G.Y. 1 ♀, same data but tree trunk, 21 Sept. 1970. 2 ♂♂, 4 ♀♀, Puerto Boyaca (Boyaca), light trap, 10 Aug. 1971, C.J.M. 4 ♂♂, 8 ♀♀, Tres Esquinas (Caqueta), light trap, 10 Nov. 1971, C.J.M. 2 ♂♂, 177 ♀♀, Curiche (Choco), biting man, Malaise, Shannon, & light traps, April-Sept. 1967, D.G.Y. 3 ♂♂, 5 ♀♀, Alto Curiche (Choco), light & Shannon traps, July 1967, D.G.Y. 2 ♀♀, Anchicaya Dam (Valle), flight trap, 10 Aug. 1973, D.G.Y. & R.C.W. 1 ♀, same data but 10 June 1975, R.C.W. 1 ♀, 25 km E of Buenaventura (Valle), light trap, 12 Aug. 1973, D.G.Y. & R.C.W. Brazil. 1 ♀, Manacapura (Amazonas), 1936. 1 ♀, near Manaus (Amazonas), 29 Oct. 1974, J. Arias. 2 ♂♂, Mata Prefeitura, Oliveira (Minas Gerais), 22 March 1960, Silva. 1 ♂, 1 ♀, M.D. de Rio Santa Antonio (Minas Gerais), 3 Jan. 1970, Silva. 5 ♂♂, 2 ♀♀, Belem (Para), flight trap, 2-5 Aug. 1974, D.G.Y. 1 ♂ (cotype), Horto Florestal, Sao Paulo (Sao Paulo), 1941, M. Barretto & J. Coutinho. 1 ♂, S. Jose Campos (Sao Paulo), at light, 11 Nov. 1940, M. Barretto & J. Coutinho. Panama. 1 ♂, 1 ♀ (paratypes of *tintinnabula*), Cerro Quia, Pinogana (Darien Prov.), 14 March 1970, F. Beam. Trinidad. 1 ♀, Bush Bush Forest, Nariva Swamp, 20 Nov. 1962, T.H.G. Aitken. Other specimens, both males & females, from Trinidad, various dates and localities, to be treated in another paper on the phlebotomine fauna of Trinidad.

*Discussion:* My treatment of *L. tintinnabula* as a junior synonym of *L. ayrozai* is based on the following considerations.

The female of *L. ayrozai*, correctly associated with the male and described by Forattini and Galati (1977), was believed earlier to be that

described by Barretto and Coutinho (1943) but, their 1943 description represented that of *L. guyanensis* (Floch and Abonnenc), not *L. ayrozai* (Barretto and Coutinho). This misled others including Christensen and Fairchild (1971) who described *L. tintinnabula* as a distinct species primarily on the basis of female characters, notably the different spermathecae and ducts. The true female of *ayrozai* and that of *L. tintinnabula* are indistinguishable, however.

The character states used in separating the males of *tintinnabula* and *ayrozai*, discussed by Christensen and Fairchild (1971), are variable and reflect intraspecific, not interspecific, variation. *Delta* of wing venation is shorter than, equal to or longer than *gamma* depending on the individual specimen. The shape of the parameres varies slightly according to geographic locality but not to the extent that it represents a difference at the species level. One feature shared by all the specimens examined is that the procoxae, mesocoxae, and areas just above them on the pleura are moderately infuscated.

*Lutzomyia ayrozai* is a widespread, anthropophilic species which probably occurs in other parts of Colombia, Brazil, and possibly Venezuela, Peru, and Ecuador. At Curiche (Choco) from April to Dec., 1967, we collected 144 females on human bait, the majority of which were taken in June (122 specimens). The total catch represented 3.8% of all biting specimens taken during this 8 month period (141 man hours).

79. *Lutzomyia* (P.) *carrerae carrerae* (NEW STATUS)  
(Fig. 65)

*Phlebotomus carrerae* Barretto, 1946d: 286 (♂ holotype, ♀, Vega Grande, Restrepo, Meta Dept., Colombia). Fairchild & Hertig, 1951a: 401

et seq. (listed, keyed). Ortiz & Alvarez, 1972: 140 et seq. (listed, cf. to *parimaensis*). Ortiz, 1972b: 222 et seq. (taxonomic discussion, figs., keyed).

?*Phlebotomus davisi*: Root, 1934: 233 (in part, ♀ only).

*Sergentomyia carrerai*: Barretto, 1955a: 82 (listed). Barretto, 1955b: 249 (cf. to *pessoana*).

*Sergentomyia pessoana* Barretto, 1955b: 247 (♂, Itatiaia, Rio de Janeiro, Brazil).

*Lutzomyia carrerai*: Barretto, 1962: 94 (listed). Barretto, 1966: 143, 144 (keyed). Martins et al., 1973a: 411-418 (taxonomic discussion, keyed). Osorno et al., 1972a: 45 (listed). Llanos et al., 1975b: 670 (Peru).

*Lutzomyia pessoana*: Barretto, 1962: 94 (listed). Barretto, 1966: 134 et seq. (♀ descr., figs., keyed, taxonomy).

*Phlebotomus pessoana*: Buck et al., 1968 (Peru).

*Psychodopygus carrerai*: Forattini, 1971a: 104 (listed). Forattini, 1971b: 173 (as a synonym of *pessoana*, *paraensis*, & *fairchildi*). Ward et al., 1973: 178 et seq. (Para, Brazil, human & rodent bait). Lainson et al., 1973: 190 (Para, Brazil). Ward & Killick-Kendrick, 1974: 216-217 (rearing data). Lainson et al., 1977 (biting man, Mato Grosso, Brazil).

*Psychodopygus pessoanus*: Forattini, 1971a: 105 (listed). Forattini, 1971b: 173-176 (as synonym of *paraensis*, *carrerai*, & *fairchildi*).

*Distribution*: Colombia (Caqueta, Meta), Brazil, Ecuador, Peru.

*Material examined*: Colombia. 3 ♂♂, 6 ♀♀, Tres Esquinas (Caqueta), light trap, 10 Nov. 1971, C.J.M. 1 ♀, Vega Grande, Restrepo (Meta), Dec. 1934, P. Antunes. 1 ♂, same data, in collection at Universidade de

Sao Paulo, Faculdade de Saude Publica. *Brazil*. 2 ♀♀, Caravelas (Bahia), Jan 1931, N. Davis. 1 ♂, 1 ♀, near Bacuri, N of Maraba (Para), flight trap, 29 Oct. 1974, J.F. Reinert. 1 ♀, same data but 1 Nov. 1974. 6 ♂♂, 40 ♀♀, near Altamira (km 165) (Para), biting man & Shannon trap, 6 Nov. 1974, J.F. Reinert. 1 ♀, same data but flight trap, 13 Nov. 1974. 1 ♂, 1 ♀, Itatiaia (Rio de Janeiro), at light, Feb. 1955, M. Barretto. *Ecuador*. 2 ♀♀, Limoncocha, near Rio Napo (Napo), flight & light traps, 20-24 May 1976, D.G.Y. & T. Rogers. *Peru*. 1 ♂, 2 ♀♀, San Antonio (Loreto), 21 Aug. 1965, J. Hitchcock.

*Discussion:* There has been much confusion concerning the status of *L. carrerai*, *L. fairchildi* Barretto, *L. pessoana*, and *L. paraensis*. Forattini (1971b) treats the first three as junior synonyms of *paraensis* but Martins et al. (1973) disagree, correctly pointing out character states which separate *paraensis* from the others. I, like them, am convinced that *paraensis* is a distinct species and that *L. pessoana* is a junior synonym of *L. carrerai* based on morphology and distribution. The status of *L. fairchildi*, a Brazilian species not discussed here, remains uncertain although the female appears to be indistinguishable from that of *L. carrerai*.

The specimens (2 ♂♂, 2 ♀♀) collected by P.C.A. Antunes at Restrepo, Colombia, misidentified by him (1937) as *Phlebotomus panamensis* Dyar, were described later as *Phlebotomus carrerai* by Barretto (1946d). The Colombian specimens seen by me, including 2 from the type series, have pale mesonota. Barretto (1946d, 1966) states that the mesonotum of *carrerai* is darker than the pleura but this appears to be incorrect. All specimens referable to *carrerai* from Colombia, Brazil, etc. are entirely pale.

The *carrerei carrerei* females share other features which should be noted. The base of the rugose section of the common sperm duct is distally tapered or "v" shaped. The area within the "v" is non-sclerotized as shown by Root (1934, fig. 3) and Fig. 65 (this paper). This feature, present in all females including the female identified as "*pessoana*" by Dr. Barretto and seen by me, is seemingly unimportant but it helps to separate the subspecies of *L. carrerei* and provides additional evidence that *carrerei* and *pessoana* are conspecific. Other character states believed to be diagnostic by Barretto (1946d, 1966) include those of the spermathecae (12-13 segments in *carrerei* vs. 10 segments in *pessoana*) and the position of the horizontal teeth of the cibarium. These are variable characteristics which, in my opinion, do not reflect specific differences in the absence of other characters.

The males of *carrerei* from Amazonia and "*pessoana*" from southern Brazil are indistinguishable. The characters of the genitalia used by Barretto (1966) and Martins et al. (1973) vary according to geographic locality and are not diagnostic by themselves.

Present data indicate that *L. c. carrerei*, a man-biter, is locally common in parts of the Amazon Basin but extends south into southern Brazil and north into Colombia, East of the Andes (*cis*-Andean distribution).

80. *Lutzomyia* (P.) *carrerei thula* n. ssp.  
(Fig. 66)

*Phlebotomus paraensis*: Fairchild & Hertig, 1951a: 404 et seq., not *paraensis* Costa Lima, 1941 (keyed, figs., descr.). Fairchild & Hertig, 1959: 122, 123 (distrib., Central America only).

*Phlebotomus pessoanus*: Hanson, 1961: 320 (breeding sites, Panama).  
Johnson & Hertig, 1961: 765 et seq. (rearing). Thatcher, 1968a: 295  
(hosts, Panama).

*Lutzomyia pessoana*: Chaniotis et al., 1971a: 344 et seq. (collecting  
data, Panama). Chaniotis et al., 1971b: 417 et seq. (biting habits, Panama).  
Tesh et al., 1972: 90, 92 (hosts, Panama). Chaniotis et al., 1972:  
94 et seq. (resting sites, Panama). Chaniotis & Correa, 1974: 115-116  
(biting activity, Panama). Chaniotis, 1974b: 501 (keyed). Rutledge &  
Ellenwood, 1975a,b,c: 71 et seq. (breeding sites, pop. dynamics, Panama).

*Lutzomyia paraensis*: Barreto, 1969: 465-466 (Valle, Colombia, not  
*paraensis* Costa Lima).

*Psychodopygus pessoanus*: Forattini, 1971a: 105 (listed). Forattini,  
1971b: 173-176 (as a synonym of *paraensis*, *pessoanus*, & *fairchildi*).  
Ward, 1976: 239 (larva, keyed).

*Distribution*: Colombia (Antioquia, Choco, Valle), Honduras, Costa  
Rica, Panama, Western Ecuador.

*Male*: As described and illustrated by Fairchild and Hertig (1951a,  
as *P. paraensis*) with the following additions based on male holotype (no.  
2328). Wing length 1.88; width 0.51. Head height 0.33; width 0.37. Eyes  
large, separated by 0.05 or by distance = to 2.2 facet diameters. Fla-  
gellomere I (0.24 long), 1.2 x length of II + III. Length of palpal  
segments: 1 (0.03), 2 (0.09), 3 (0.12), 4 (0.04), 5 (0.04); palpal sen-  
silla (ca. 10) on distal 3/4 of segment 3. Labrum length 0.20. Pharynx  
length 0.18. Pleura with 17 upper and 5-11 lower episternal setae.  
Length of wing vein sections: *Alpha* (0.43), *beta* (0.26), *delta* (0.16),  
*gamma* (0.12). Length of femora, tibiae, and basitarsi: Foreleg, 0.78,  
1.13, 0.76; midleg, 0.74, 1.26, 0.78; hindleg, 0.88, 1.38, 0.88. Style

(0.12 long). Coxite (0.19 long x 0.05 wide). Lateral lobe (0.26 long). Genital pump (0.18 long), each filament 0.50 long or 2.8 x length of pump.

*Female:* As described and illustrated by Fairchild and Hertig (1951a, as *P. paraensis* with the following additions based on female allotype (no. 2228). Wing length 2.15; width 0.66. Head height 0.41; width 0.37. Eyes large, separated by 0.08 or by distance = to 4.5 facet diameters. Flagellomere I (0.25 long), 1.2 x length of II + III length of palpal segments: 1 (0.06), 2 (0.13), 3 (0.17), 4 (0.05), 5 (0.06). Labrum length 0.36. Pharynx length 0.19. Pleura with 13-18 upper and 6-8 lower episternal setae. Length of wing vein sections: *Alpha* (0.62), *beta* (0.25), *delta* (0.31), *gamma* (0.18). Length of femora, tibia, and basitarsi: Foreleg, 0.81, 1.15, 0.76; midleg, 0.76, 1.32, 0.80; hindleg, 0.88, 1.47, 0.88.

*Material examined:* *Panama.* ♂ holotype (no 2328), Cerro Campana (Panama Prov.), Shannon trap, 24 Aug. 1950, M. Hertig & G. Fairchild. ♀ allotype (no. 2228), same data but biting man, 21 June 1950. 15 ♀♀ paratypes (nos. 2223-2227 & 2229-2240), same data as allotype. 2 ♂♂, 11 ♀♀ paratypes (nos. 634-646), Rio Changena (Bocas del Toro), Shannon trap, 8 Sept. 1961, P. Galindo. 2 ♂♂ paratypes (nos. 647-648), upper Pacora River (Panama Prov.), light trap, 21 Oct. 1953, F.S. Blanton. *Colombia.* 2 ♂♂, 4 ♀♀ paratypes (nos. 649-654), Rio Anori (Antioquia), light traps, Sept. 1970, D.G.Y. *Honduras.* 1 ♂ paratype (no. 4541), Lancetilla Valley, Tela, light trap, 25 Nov. 1953, W. Hils. Other specimens, mostly preserved in alcohol but not part of the type series include the following. *Colombia.* 1 ♀, Rio Anori (Antioquia), light trap, 19 April 1970, C.H.P. 8 ♂♂, 4 ♀♀, same data but May 1970. 7 ♂♂, 10 ♀♀,



same data but Sept. 1970, D.G.Y. 5 ♂♂, 16 ♀♀, Curiche (Choco), June-July, Sept., Nov. 1967. 9 ♂♂, 89 ♀♀, same data but Teresita (Choco), April-Nov., 1967. 1 ♂, 25 km E of Buenaventura (Valle), light trap, 12 Aug. 1973, D.G.Y. & R.C.W. *Costa Rica*. 1 ♀, N of Marina (Alajuela) under dead leaves, 13 Feb. 1960, W.J. Hanson. *Ecuador*. 1 ♀, 16 km E of Santo Domingo de Los Colorados (Pichincha), flight trap, 28 May 1976, D.G.Y., T. Rogers, & G. Fairchild.

*Discussion:* Unlike Barretto (1966), I am convinced that *L. carrerai* (Barretto) is not only conspecific with *L. pessoana* (Barretto) but that it differs from the taxon described as *Phlebotomus paraensis* by Fairchild and Hertig, 1951a, and subsequently identified as *L. pessoana* by other workers in Panama. Accordingly, I am assigning this taxon a new name *L. carrerai thula*, the subspecific epithet being derived from the Latin word, "thule," meaning farthest north.

This form and the nominate subspecies are allopatric, the former subspecies occurring west of the Andes from Ecuador to Colombia, then into Panama and Central America (*trans*-Andean distribution, Haffer, 1967, 1974). *Lutzomyia c. carrerai* although widespread in the Amazon Basin and southwards, does not extend into Central America (*cis*-Andean distribution).

The following character states, seemingly minor but consistent, are used to separate the females. The length of the labrum of *L. c. carrerai* (n = 20) from various localities ranges from 0.24 mm to 0.27 mm (average length 0.25 mm). The labrum is shorter than the combined length of the pedicel and the first flagellomere. In contrast, the labrum of *L. c. thula* is much longer, ranging from 0.33-0.45 (average length 0.38, n = 21) and is greater than the length of the pedicel + flagellomere I. The

palpi are longer in *thula* as well. The "v" shaped clearing at the base of the rugose section of the common sperm duct is conspicuous in females of the nominate subspecies but is absent or nearly absent in females of *L. c. thula*. I am not able to separate the males of these subspecies without knowledge of locality or in the absence of females. The eggs of each appear to be similar (Ward and Ready, 1975; Zimmerman et al., 1977) but further study is needed to detect possible differences. Hanson (1968) partially illustrated the fourth instar larva of *thula* (as *pessoanus*) noting that it and the pupa are almost indistinguishable from those of *L. panamensis*.

We collected a total of 135 females of *L. c. thula* in routine human bait collections at Curiche in May and June 1967 (52 man hours). One specimen was taken in April (17 man hours), 2 in August (25 man hours) but none was collected in July, Sept. to Nov., 1967 (47 man hours). Based on soil emergence traps (Rutledge and Ellenwood, 1975a), specimens of *L. c. thula* (as *pesscana*) were most common from May to August in Panama. Other information on the bionomics of this taxon in Panama include the following. Most adults rest on the undersides of green leaves during the day (Chaniotis et al., 1971a, 1972). Females are anthropophilic, being especially common in mature forests where they bit primarily at ground level (Chaniotis et al., 1971b) during the day and night. Precipitin tests indicate that a variety of mammals are fed upon, the edentates accounting for the majority (72.9%) of 96 reacting blood meals in one study (Tesh et al., 1972). Immature stages have been recovered from the open forest floor (Hanson, 1968, Rutledge and Ellenwood, 1975a).

81. *Lutzomyia (P.) davisí*  
(Fig. 67)

*Phlebotomus davisí* Root, 1934: 242 (♂ holotype, Fordlandia, Para, Brazil; ♀, not *davisí* Root). Barretto, 1947: 196 (cataloged). Fairchild & Hertig, 1951a: 401 et seq. (discussed, keyed). Floch & Abonnenc, 1952: 157 (French Guiana, ♂, figs.). Forattini, 1960: 468 et seq. (in part, ♂ only, figs.). Ortiz & Alvarez, 1972: 140 (cf. to *parimaensis*). Ortiz, 1972b: 222 et seq. (discussed, keyed, ♂ figs.; ♀ not *davisí* Root).

*Phlebotomus rooti* Mangabeira, 1942a: 112 (♂, Aura, Belem, Para, Brazil). Fairchild & Hertig, 1951a: 402 et seq. (discussed, keyed). Ortiz & Alvarez, 1972: 140 (cf. to *parimaensis*). Ortiz, 1972b: 222 et seq. (in part, keyed, figs.).

*Lutzomyia davisí*: Barretto, 1962: 94 (listed). Barretto, 1966: 142 (keyed; ♀ not *davisí* Root). Lewis et al., 1970: 212 et seq. (parous rates, ovariole fig.). Osorno et al., 1972a: 46 (Caqueta, Colombia). Llanos, 1973: 31 (♂, ♀, descr., figs., Peru). Martins et al., 1973b: 419 (♀ descr., refs.). Lewis, 1975a: 502 et seq. (mouthpart morphol.). Llanos et al., 1975b: 670 (Peru). Llanos et al., 1976: 480 (Peru).

*Lutzomyia rooti*: Barretto, 1962: 94 (listed). Barretto, 1966: 142 (keyed). Martins et al., 1973b: 419 (as synonym of *davisí*).

*Psychodopygus davisí*: Forattini, 1971a: 105 (listed). Forattini, 1973: 163 et seq. (in part, ♂ only, gen. review). Ward & Ready, 1975: 128 (egg, figs.). Ward, 1976: 233 (larva descr., fig.). Lainson et al., 1977 (Rio Aripuana, Mato Grosso, Brazil).

*Psychodopygus rooti*: Forattini, 1971a: 105 (as synonym of *davisí*). Ward et al., 1973: 178 (Para, Brazil). Lainson et al., 1973: 190 (Para, Brazil).

*Distribution:* Colombia (Amazonas, Caqueta), Ecuador, Peru, Bolivia, French Guiana, Brazil.

*Material examined:* Colombia. 3 ♂♂, 1 ♀, 18 km W of Leticia (Amazonas), light trap, 26 July 1973, D.G.Y. & R.C.W. 5 ♂♂, 4 ♀♀, Tres Esquinas (Caqueta), light trap, 10 Aug. 1971, C.J.M. Brazil. 1 ♂, Rio Aripuana at Humboldt (Mato Grosso), tree trunk, 20 Aug. 1974, D.G.Y. & J. Shaw. 4 ♂♂, 6 ♀♀, Belem (Para), flight trap, 30 July-6 Aug. 1974, D.G.Y. 1 ♂, 8 ♀♀, near Bacuri, N of Maraba (Para), biting man, light, Shannon & flight traps, 23-31 Oct. 1974, J.F. Reinert. 11 ♀♀, W of Altamira, km 164 (Para), biting man, 6 Nov. 1974, J.F. Reinert. 5 ♂♂, 12 ♀♀, same data but Shannon & flight traps, 6-7, 12 Nov. 1974. Ecuador. 1 ♂, 1 ♀, Rio Napo at Limoncocha (Napo), flight trap, 19 May 1976, D.G.Y. & T. Rogers.

*Discussion:* *Lutzomyia davisii*, an anthropophilic species (Ward et al., 1973), is widely distributed in the Amazon basin, occurring as far north as central Colombia, east of the Andes.

A recently described, but doubtfully distinct, species from Venezuela, *L. parimaensis* (Ortiz and Alvarez) may be conspecific with *davisii* but the male is unknown and I have not seen the holotype female or paratypes.

Forattini (1973) refers *Phlebotomus* sp. no. 780 of Floch and Chassignet, 1948, to *davisii* but this is questionable based on the description and figures of that taxon (♀ only) and by the fact that Forattini (1960, 1973) misassociated the sexes of *davisii*. *Phlebotomus* sp. no. 780 is more likely the female of *L. hirsuta* but this is only speculation as I have not examined material referable to *P.* sp. no 780 from French Guiana.

The true identity of the *davisi* female was confused for many years but Martins et al. (1973b) correctly associated the sexes and reviewed the literature, clarifying misidentifications of others. Based on their studies and those of my own, I also have no doubt that *L. rooti* is conspecific with *L. davisi*.

82. *Lutzomyia* (*P.*) *guyanensis*  
(Fig. 68)

*Phlebotomus guyanensis* Floch & Abonnenc, 1941a: 17 (♀ holotype, Montana Lucifer, French Guiana). Barretto, 1947: 203 (refs.). Fairchild & Hertig, 1951a: 401, 404 (mention, keyed). Floch & Abonnenc, 1952: 173 (♀, redescr., figs.). Ortiz & Alvarez, 1972: 140 (mention). Ortiz, 1972b: 221 et seq. (♀, keyed, figs., discussion).

*Phlebotomus geniculatus* Mangabeira, 1941a: 245 (♂ holotype, Aura, Belem, Para, Brazil). Fairchild & Hertig, 1951a: 401 et seq. (♂, ♀, descr., figs., Panama). Bruijning, 1957: 229 (Surinam). Lewis & Garnham, 1959: 80-81 (♀, figs., Belize). Johnson & Hertig, 1961: 765 (rearing). Hanson, 1968: 58 (larva descr., figs.).

*Phlebotomus ayrozai*: Barretto & Coutinho, 1943: 183 (♀ not Barretto & Coutinho, 1943).

*Lutzomyia geniculata*: Barretto, 1962: 94 (listed). Barretto, 1966: 141, 145 (keyed). Williams, 1970: 332 (Belize). Osorno et al., 1972a: 46 (Caqueta, Colombia). Lewis, 1975a: 502 et seq. (mouthpart morphol.). Llanos et al., 1975b: 670 (Peru).

*Lutzomyia guyanensis*: Barretto, 1962: 94 (listed). Barretto, 1966: 145 (keyed). Lewis, 1975a: 502 et seq. (mouthpart morphol.).

*Psychodopygus geniculatus*: Forattini, 1971a: 105 (listed).

Forattini, 1973: 124 et seq. (as synonym of *guyanensis*). Shaw et al., 1972: 720 (biting man). Ward et al., 1973: 178 (biting man, Para, Brazil). Lainson et al., 1973: 190 (Para, Brazil). Ward, 1976: 239 (larva keyed).

*Psychodopygus guyanensis*: Forattini, 1971a: 105 (listed).

Forattini, 1973: 124 et seq. (gen. review). Forattini & Galati, 1977: 25 (♀, cf. to *ayrosai*).

*Distribution*: Belize, Panama, Colombia (Caqueta, Choco), Ecuador, Peru, Surinam, Brazil.

*Material examined*: Colombia. 1 ♂, 2 ♀♀, Tres Esquinas (Caqueta), light trap, 10 Nov. 1971, C.J.M. 117 ♀♀, Curiche (Choco), biting man, light & Shannon traps, June-Sept. 1967. 16 ♀♀, Alto Curiche (Choco), biting man, light traps, June-Sept. 1967. Brazil. 6 ♀♀, Belem (Para), light trap, 18 Oct. 1972, D.G.Y. 1 ♀, Cabeça da Anta (Sao Paulo), at light, 1941, M. Barretto & J. Coutinho. Ecuador. 6 ♂♂, 208 ♀♀, Rio Napo at Limoncocha (Napo), light traps, 19-23 May 1976, D.G.Y. & T. Rogers. 5 ♀♀, same data but flight traps. Panama. 8 ♀♀, Almirante (Bocas del Toro), Shannon trap, 22 June 1951, W. Hils. 1 ♂, same data but light trap, 30 March 1953, A. Quinones.

*Discussion*: Although Forattini (1973) is probably correct in treating *L. geniculata* as a junior synonym of *L. guyanensis*, there remains the possibility that they are distinct taxa. Additional material, particularly males, from or near the type locality of *guyanensis*, is needed to confirm the synonymy.

At Curiche in 1967, we collected 102 *guyanensis* females biting man, the majority of which were taken in June (98 specimens, 24 man hours).

The remaining 4 man-biting females were captured in July and August (43 man hours). Williams (1970) in Belize dissected 19 females but found no flagellates. He captured specimens on dead leaves on the forest floor, on man, in light traps, and in a rodent-baited Disney trap.

83. *Lutzomyia* (P.) *hirsuta hirsuta* NEW STATUS  
(Fig. 67)

*Phlebotomus hirsutus* Mangabeira, 1942a: 116 (♂ holotype, Piratuba, Abaete, Para, Brazil). Forattini, 1960: 477 (Amapa, Brazil). Ortiz & Alvarez, 1972: 140 (listed). Ortiz, 1972b: 222 et seq. (♂, keyed, figs.).

*Phlebotomus colas-belcouri* Floch & Chassignet, 1947a: 1 (♂, holotype, Baduel, French Guiana). Barretto, 1953: 209 (as synonym of *hirsuta*). Barretto, 1966: 134 (full refs.).

?*Phlebotomus* sp. no 780 Floch & Chassignet, 1948: 1 (♀, Baduel, French Guiana).

*Phlebotomus davisi*: Forattini, 1960: 468 (in part, ♂ only, figs.).

*Lutzomyia hirsuta*: Barretto, 1962: 94 (listed). Barretto, 1966: 134 (full refs.). Young, 1973: 108 (mention). Martins et al., 1973b: 420 (mention).

*Phlebotomus paraensis*: Buck et al., 1968 (not *paraensis* Costa Lima, Peru).

*Psychodopygus hirsutus*: Forattini, 1971a: 105 (listed). Forattini, 1973: 397 et seq. (in part, ♂ only, figs.). Ward et al., 1973: 178 (biting man, Para, Brazil). Lainson et al., 1977 (Rio Aripuana, Mato Grosso, Brazil).

*Lutzomyia paraensis*: Osorno et al., 1972a: 48 (not *paraensis* Costa Lima; Caqueta, Colombia).

*Psychodopygus amazonensis*: Ward et al., 1973: 178 (in part, ♂ only).

*Psychodopygus davisi*: Forattini, 1973: 407-408 (in part, ♂ only, figs.).

*Lutzomyia* sp. "c." Velasco, 1973: 84 (♀, Cerro de Polini, Bolivia).

*Distribution*: Colombia (Caqueta), Ecuador, Peru, Bolivia, French Guiana, Brazil.

*Material examined*: Colombia. 6 ♂♂, 13 ♀♀, Tres Esquinas (Caqueta), light trap, 10 Nov. 1971, C.J.M. 1 ♂, 2 ♀♀, El Palmar, Solano (Caqueta), light trap, 31 March 1972, C.J.M. (INPES). Bolivia. 1 ♀, Cerro de Polina (Nor Yungas), tree buttress, 30 June 1971, J. Velasco. Brazil. 2 ♀♀, Serra do Navio (Amapa), light trap, 21 Sept. 1972, D.G.Y. & H. Fraiha. 1 ♀, near Bacuri, N of Maraba (Para), flight trap, 22 Oct. 1974, J. Reinert. 1 ♂, 1 ♀, W of Altamira, km 164 (Para), Shannon trap, 6 Nov. 1974, J. Reinert. Ecuador. 15 ♂♂, 36 ♀♀, Rio Napo at Limoncocha (Napo), light traps, 19-24 May 1976, D.G.Y. & T. Rogers. 1 ♂, 3 ♀♀, same data but flight traps. Peru. 2 ♀♀, San Antonio (Loreto), 22 Aug. 1965, J. Hitchcock.

*Discussion*: There are two distinct, allopatric populations of *L. hirsuta*, now separated by a large area extending from northern Colombia to western Panama. Males from the Central American population were described as *Phlebotomus nicaraguensis* Fairchild and Hertig, but I now believe that this taxon and *L. hirsuta* (Mang.) should be treated as subspecies (see discussion on p. 338). *Lutzomyia h. hirsuta* occurs in Colombia but not *L. h. nicaraguensis*, the female of which closely resembles that of the nominate subspecies. They differ mainly from other



*Psychodopygus* females by the shape of the common sperm duct, i.e., the rugose section is relatively narrow at the base but becomes noticeably swollen apically where the individual ducts join. In other words, the shape of the rugose section is similar to that of a tapered carrot. The remaining section of the common duct is partially striated, the thickenings forming incomplete lines or distinct dots. In this respect the common duct of *L. davisi* is similar but the rugose part of the sperm duct of that species is not swollen apically and the individual ducts are longer (Fig. 67). *Phlebotomus* sp. no. 780 of Floch and Chassignet, discussed earlier under *davisi*, resembles *hirsuta* in the shape of the common sperm duct but it appears to be heavily rugose throughout its length (Floch and Chassignet, 1948, fig. 1). If this is actually the case, then sp. no. 780 is a distinct species but, if not, then it probably represents *L. h. hirsuta*, the male of which was taken also at Baduel, French Guiana (Floch and Chassignet, 1947a).

It seems appropriate here to describe the previously unknown female of *L. h. nicaraguensis* based on 5 specimens from Bocas del Toro Prov., Panama.

*Phlebotomus nicaraguensis* Fairchild & Hertig, 1961a: 26 (♂, holotype, Villa Somoza, Nicaragua).

*Female* (Fig. 12): Wing length 2.10-2.42; width, 0.68-0.73. Head, mesonotum, and abdominal tergites strongly pigmented, contrasting with pale pleura. Procoxae nearly as dark as mesonotum, other coxae pale (all coxae pale in *L. hirsuta hirsuta*). Head height 0.40-0.43; subequal to width. Eyes separated by 0.12 or distance = to ca. 6 facet diameters. Flagellomere I (0.27-0.29 long), 1.3 x length of II + III; ascoids nearly reaching end of flagellomeres, on all except last 3. Length of palpal

segments: 1 (0.05-0.06), 2 (0.17-0.20), 3 (0.19-0.20), 4 (0.06), 5 (0.07-0.09); palpal sensilla (ca. 12) on distal 1/3 of segment 3. Labrum 0.37-0.42 long. Cibarium with 4 horizontal teeth, spaced as shown, the median pair inclined towards middle; pigment patch as shown, moderately pigmented; pharynx 0.18-0.20 long, unarmed. Pleura with 12-30 upper and 6-11 lower episternal setae. Length of wing vein sections: *Alpha* (0.23-0.29), *beta* (0.11-0.13), *delta* (0.08-0.12), *gamma* (0.06-0.10). Length of femora, tibiae, and basitarsi of slide 7943: Foreleg, 0.88, 1.42, 0.95; midleg, 0.83, 1.55, 1.05; hindleg, 0.98, 1.85, 1.11. Abdominal sternite 2 with a pair of lateral clear spots posteriorally. Tergite 8 with 10-30 setae on each side. Spermathecae and ducts as in Fig. 12.

*Material examined:* Panama. 4 ♂♂, 5 ♀♀, Rio Changena (Bocas del Toro), Shannon trap, 7-11 Sept. 1961, P. Galindo & R. Hartmann. *Nicaragua*. ♂ holotype, Villa Somoza, 15 June 1953, P. Galindo & H. Trapido.

*Discussion:* I associated the sexes on the basis of collecting data, similar coloration, and by the fact that no other possible mates were taken at Rio Changena. Except for the dark procoxae (pale in *h. hirsuta*), the female of *nicaraguensis* is indistinguishable from that of the nominate subspecies. The males are separated by this same feature and by the genitalic characters discussed by Fairchild and Hertig (1961a).

84. *Lutzomyia* (P.) *nocticola*  
(Fig. 69)

*Lutzomyia nocticola* Young, 1973: 109 (♂ holotype, ♀, Rio Anori, Antioquia, Colombia).

*Distribution:* Panama, Colombia (Antioquia), Ecuador.

*Material examined:* Colombia. 1 ♂, 7 ♀♀ (including holotype & allotype), Rio Anori (Antioquia), light traps, May 1970, C.H.P. 6 ♂♂,

6 ♀♀, same data but Sept. 1970, D.G.Y. *Ecuador*. 28 ♂♂, 37 ♀♀, Rio Napo at Limoncocha (Napo), light traps, 19-24 May 1976, D.G.Y. & T. Rogers. 1 ♂, 7 ♀♀, same data but flight traps. *Panama*. 1 ♂, 4 ♀♀, Rio Changena (Bocas del Toro), Shannon trap, 8 Sept. 1961, P. Galindo & H. Trapido.

*Discussion:* Specimens of *nocticola* from western Panama, Colombia (Antioquia), and Limoncocha, Ecuador, are morphologically indistinguishable although the populations are widely separated. Future collections east of the Andes, may reveal its presence in other Colombian localities but it seems likely that the *nocticola* population in western Panama is truly isolated from those in South America. Practically nothing is known about the habits of this recently described species.

85. *Lutzomyia* (P.) *panamensis*  
(Fig. 70)

*Phlebotomus panamensis* Shannon, 1926: 192 (♂ holotype, ♀, Cano Saddle, near Catun, Canal Zone). Barretto, 1947: 216 (complete refs.). Fairchild & Hertig, 1951a: 399 et seq. (♂, ♀, descr., discussed, figs.). Osorno et al., 1967: 28 (Meta, Colombia). Morales et al., 1969a: 381 (Meta, Colombia). Ortiz, 1972b: 22 et seq. (♂, ♀, keyed, figs.). Ortiz & Alvarez, 1972: 140 (listed).

*Lutzomyia panamensis*: Barretto, 1962: 94 (listed). Theodor, 1965: 188 (listed, figs.). Barretto, 1966: 142, 144 (keyed). Barreto, 1969: 465 et seq. (Valle, Colombia). Tesh et al., 1971a: 153 (blood meals). Osorno et al., 1972a: 47-48 (Colombian records). Tesh et al., 1972: 90 (blood meals). Young, 1973: 108 (mention). Chaniotis & Correa, 1974: 115 (biting habits, Panama). Chaniotis, 1974b: 501 (keyed). Lewis, 1975a: 502 et seq. (mouthpart morphol.). Rutledge & Ellenwood, 1975a:

72 et seq. (breeding sites, refs. on bionomics). Rutledge et al., 1975: 179 (ecology, Panama). Williams, 1976a: 604 (in caves, Belize).

*Phlebotomus pessoanus*: Strangways-Dixon & Lainson, 1966: 192 (not *pessoana* Barretto, 1955, Belize).

*Psychodopygus panamensis*: Lewis, 1965: 376 et seq. (internal morphol.). Forattini, 1973a: 89 et seq. (gen. review, figs., ♂, ♀). Ward, 1976: 239 (larva keyed).

*Distribution*: Mexico, Central America, Colombia (Antioquia, Boyaca, Caldas, Caqueta, Choco, Guajira, Meta, Norte de Santander, Santander, Valle), Ecuador, Peru, Brazil, Venezuela.

*Material examined*: Colombia. 40 ♂♂, 45 ♀♀, Rio Anorí (Antioquia), light traps, May 1970, C.H.P. 5 ♂♂, 8 ♀♀, same data but Sept. 1970, D.G.Y. 4 ♀♀, Puerto Boyaca (Boyaca), light trap, 10 Aug. 1971, C.J.M. 1 ♂, 4 ♀♀, same data but 6 May 1973. 5 ♂♂, 6 ♀♀, Tres Esquinas (Caqueta), light trap, 10 Nov. 1971, C.J.M. 65 ♂♂, 2386 ♀♀, Curiche (Choco), biting man, light, Shannon, & Malaise traps, April-Dec. 1967, D.G.Y. 12 ♂♂, 474 ♀♀, same data but Alto Curiche, June-Dec., 1967. 72 ♂♂, 1528 ♀♀, same data but Teresita, March-Dec. 1967. Ecuador. 1 ♀, 16 km E of Santo Domingo de Los Colorados (Pichincha), flight trap, 28 May 1976, D.G.Y., T. Rogers, & G. Fairchild. Panama. 3 ♂♂, Almirante (Bocas del Toro), tree buttress, 21 June 1950, R. Hartmann. 5 ♀♀, Juan Mina (Canal Zone) biting man in daytime, Sept. 1949, H. Trapido. Numerous other specimens from Panama, Mexico, Nicaragua, and Venezuela in collection at UF.

*Discussion*: *Lutzomyia panamensis*, a widely distributed, strongly anthropophilic species, was the dominant man biter at Curiche, Alto Curiche, and Teresita during medical ecology studies in the Choco in 1967. At Curiche, we captured a total of 1751 *panamensis* females on human bait

from April to December (141 man hours), over half of which were taken in June (624 ♀♀, 24 man hours). One extraordinary biting collection on 8 June from 2000 to 2200 hours (4 man-hours) yielded 1151 *Lutzomyia* females of 11 species. *Lutzomyia panamensis* accounted for 250 of these.

Most of the information on the bionomics and disease relationships of this important species is summarized by Forattini (1973). A few additional papers, published since then, are cited here in the species bibliography.

86. *Lutzomyia* (P.) *recurva*  
(Fig. 71)

*Lutzomyia recurva* Young, 1973: 106 (♂ holotype, ♀, Curiche, Choco, Colombia). Lewis, 1975a: 505 (listed).

*Distribution:* Panama (Darien), Colombia (Choco).

*Material examined:* Colombia. 11 ♂♂, 480 ♀♀, Curiche (Choco), biting man & light, Shannon, & Malaise traps, April-Dec. 1967, D.G.Y. Panama. 1 ♂, 2 ♀♀, Altos de Quia (Darien), 1970, F. Beam (GML collection).

*Discussion:* *Lutzomyia recurva* and *L. amazonensis* (Root, 1934), both anthropophilic, apparently are closely related. The male of the latter species, unknown for many years, was recently described by Llanos et al. (1975b). It and *recurva*, unlike the other series *panamensis* males, possess a slender, arched dorsobasal arm on each paramere but differ from each other in the shape and setation of the paramere.

*Lutzomyia recurva*, known only from Choco Dept., Colombia, and Darien Prov., Panama, occurs well outside the range of *amazonensis*. Specific data on human biting collections of *recurva* were given in an earlier paper (Young, 1973).

87. *Lutzomyia* (P.) sp. of Tres Esquinas  
(Fig. 61)

*Female* (description based on 3 ♀♀): Wing length 2.0-2.3; width 0.6. Mesonotum and abdominal tergites well pigmented, head less so, rest of insect pale. Head height 0.41-0.45; width 0.38-0.40. Eyes separated by 0.10-0.11 or by distance = to ca. 5.2 facet diameters. Flagellomere I (0.23-0.25 long), 1.2 x length of II + III; ascoids simple, reaching to or beyond ends of their respective segments, on all but last 3 flagellomeres. Length of palpal segments: 1 (0.05), 2 (0.13-0.14), 3 (0.15-0.16), 4 (0.05), 5 (0.08); palpal sensilla (8-12) on distal 1/3 or segment 3. Labrum 0.30-0.33 long. Cibarium with 4 horizontal teeth arranged as shown (1 ♂ has 5) and 15-20 vertical teeth, those in middle enlarged; chitinous arch not visible; pigment patch well defined, moderately pigmented. Pharynx 0.20 long, unarmed. Pleura with 10-19 upper and 6-7 lower episternal setae. Length of wing vein sections: *Alpha* (0.45-0.61), *beta* (0.21-0.31), *delta* (0.05-0.16), *gamma* (0.18-0.20). Length of femora, tibia, and basitarsi of slide 658: Foreleg (missing), midleg, 0.83, 1.4, 0.88; hindleg, 0.93, 1.6, 0.98. Abdominal sternites entire, lacking clear areas. Tergite 8 with 10+ setae on each side. Spermatheca with 6-8 well formed annuli, the terminal one symmetrical; individual sperm duct over 2 x length of spermatheca; common duct as shown, the apical 1/5 rugose and with transverse striations appearing as complete lines, the remainder with incomplete striations more pronounced and numerous on the basal half of duct. Cerci unremarkable.

*Distribution:* Colombia (Caqueta).

*Material examined:* Colombia. 3 ♀♀, Tres Esquinas (Caqueta), light trap, 10 Nov. 1971, C.J.M.

*Discussion:* I hesitate to formally name this species because the male is unknown and because I am not entirely convinced that it and *L. guyanensis* are distinct taxa. Except for differences in the sperm ducts and slightly longer individual ducts of the Tres Esquinas specimens, the females appear to be indistinguishable.

Figure 61

*Lutzomyia* (P.) *bermalei* -- A. Male genitalia (after Osorno et al., 1967).

Male: Araracuara, Caqueta Intendencia, Colombia

*Lutzomyia* (P.) *chugasi* -- B. Male genitalia.

Male: Tres Esquinas, Caqueta Intendencia, Colombia

*Lutzomyia* sp. of Tres Esquinas, female -- C. Cibarium, D. Head, E. Flagellomere II, F. Wing, G. Spermathecae.



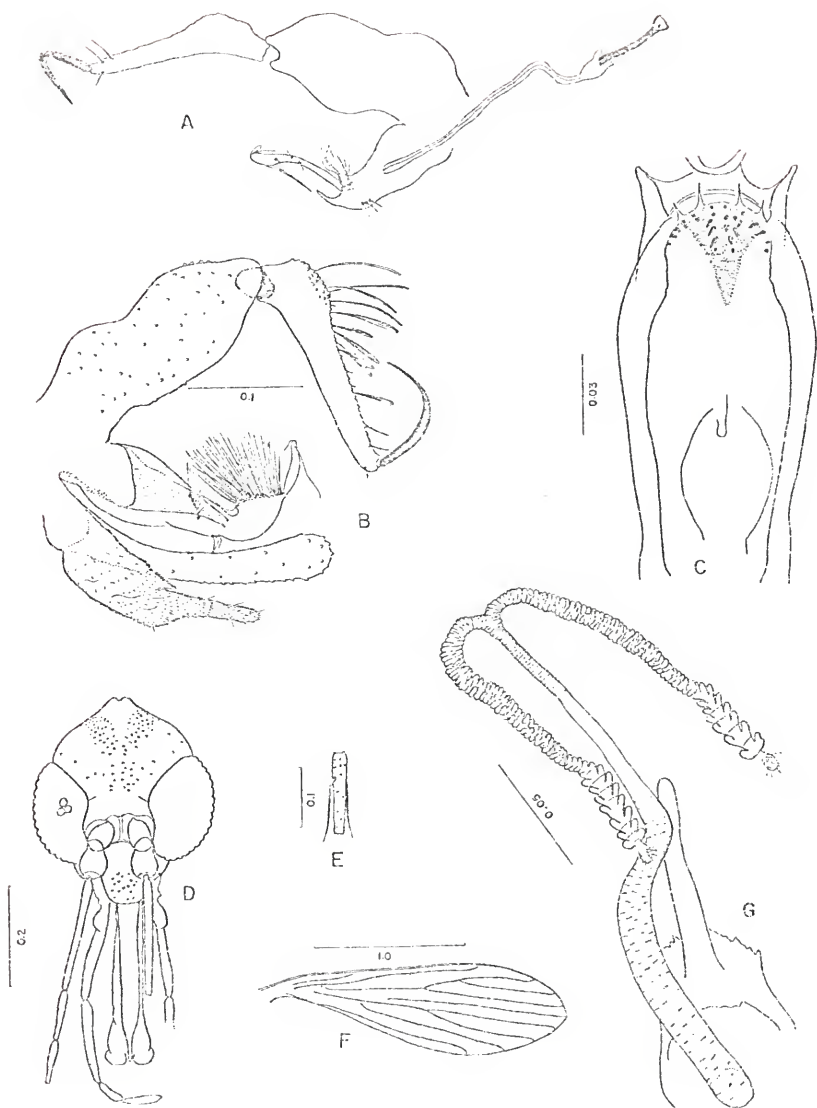


Figure 62

*Lutzomyia (P.) fairtigi* -- A. Male head, B. Male flagellomere II, C. Female head, D. Male flagellomere II, E. Spermathecae, F. Paramere, G. Male genitalia, H. Female cibarium, I. Female cibarium and pharynx, J. Female wing, K. Male wing.

Male: Villavicencio, Meta Dept., Colombia

Female: Same locality as male

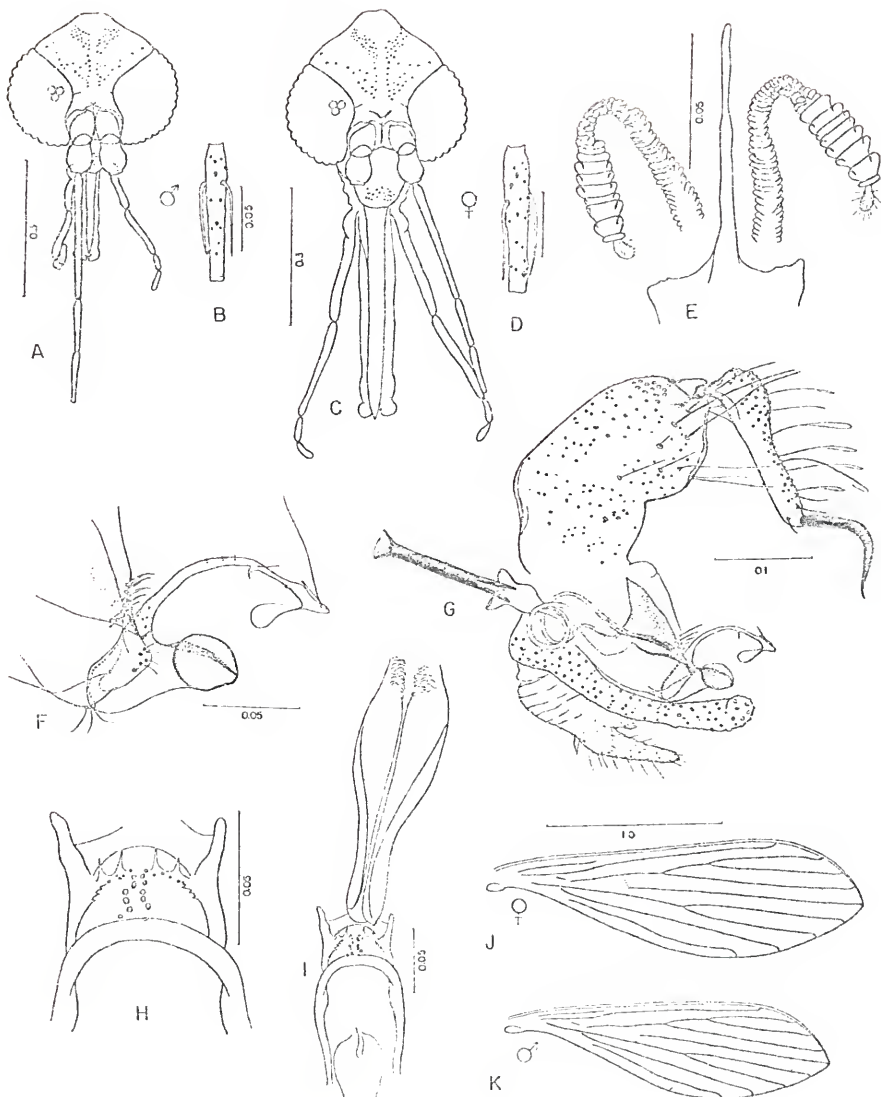


Figure 63

*Lutzomyia (P.) bispinosa* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, G. Genital pump and filaments, same scale as Fig. 63F, H. Body of spermatheca, I. Spermathecae, J. Female wing, K. Male wing, L. Female cibarium.

Male: Cerro Jefe, Panama Prov., Panama

Female: Curiche, Choco Dept., Colombia

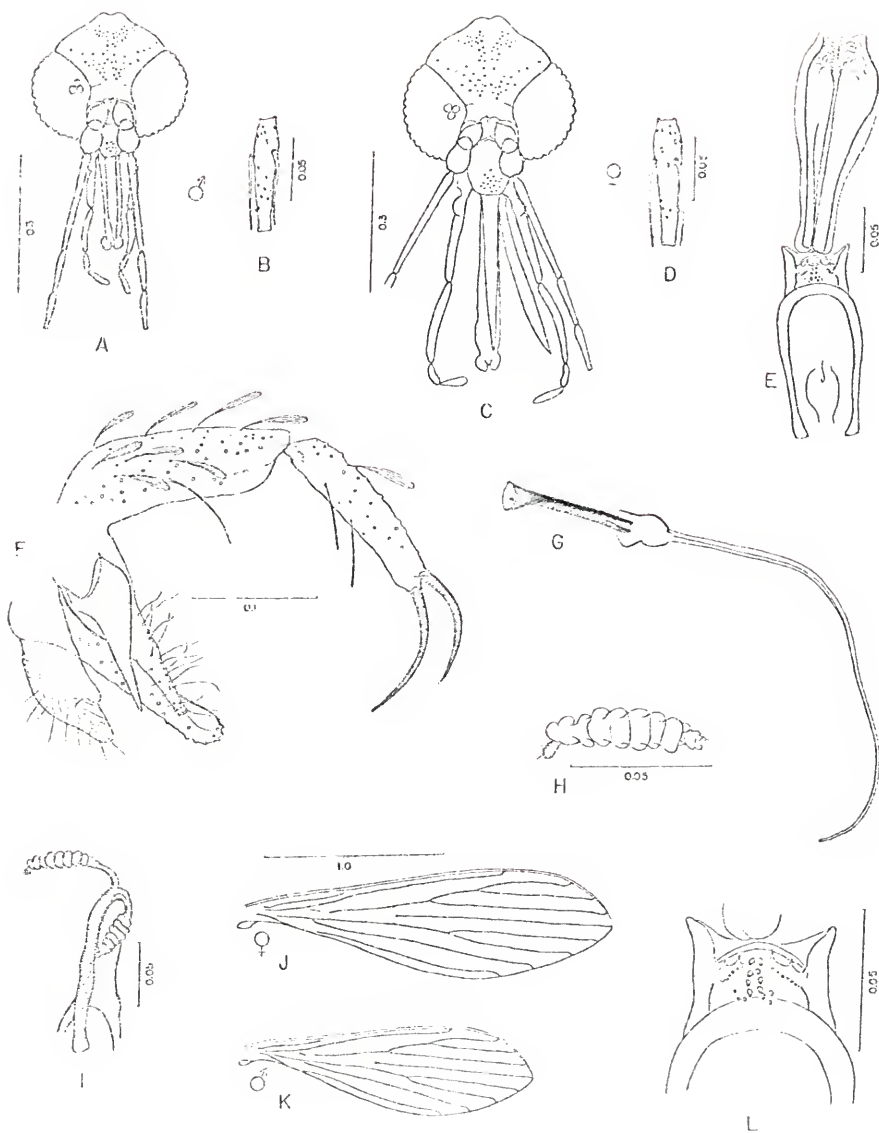


Figure 64

*Lutzomyia (P.) ayrozai* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Genital pump and filaments, G. Male genitalia, H. Body of spermatheca, I. Spermathecae, J. Female wing, K. Male wing, L. Female cibarium.

Male: Curiche, Choco Dept., Colombia

Female: Same locality as male

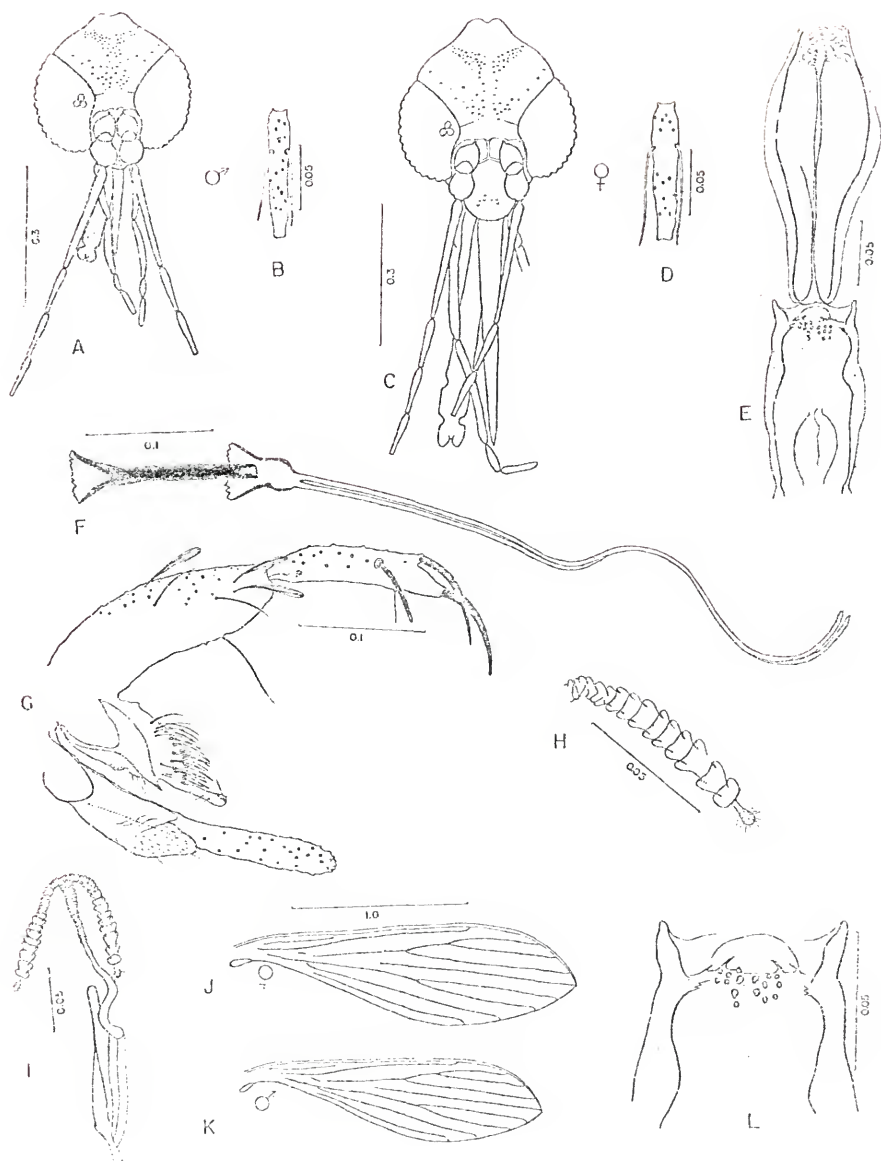


Figure 65

*Lutzomyia (P.) carrerai carrerai* -- A. Male genitalia, B. Spermathecae,  
C. Female head.

Male: Tres Esquinas, Caqueta Intendencia, Colombia  
Female: Same locality as male



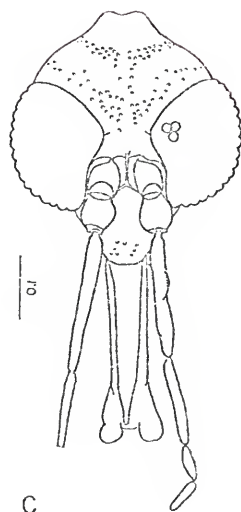
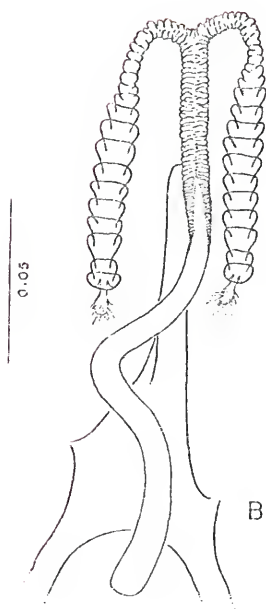
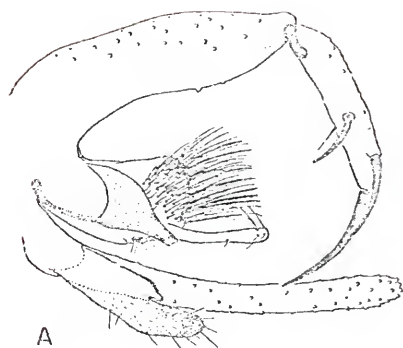


Figure 66

*Lutzomyia (P.) carrerai thula* -- A. Male genitalia, B. Female head, Panamanian specimen, C. Spermathecae, D. Female cibarium.

Male: Curiche, Choco Dept., Colombia

Female: Same locality as male (except Fig. 66B)

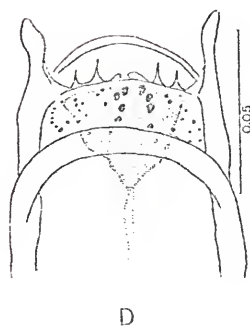
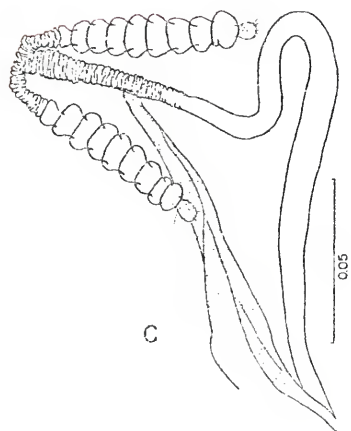
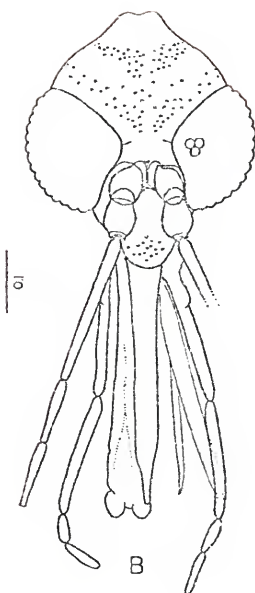
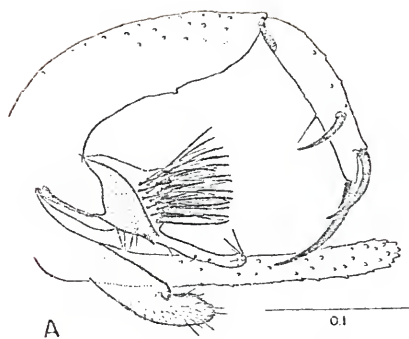


Figure 67

*Lutzomyia (P.) davisi* -- A. Spermathecae of female from Para State, Brazil, B. Male genitalia, C. Female cibarium.

Male: Tres Esquinas, Caqueta Intendencia, Colombia.

Female: Same locality as male (except Fig. 67A)

*Lutzomyia (P.) hirsuta hirsuta* -- D. Spermathecae, E. Male genitalia, F. Female cibarium.

Male: Tres Esquinas, Caqueta Intendencia, Colombia

Female: Same locality as male

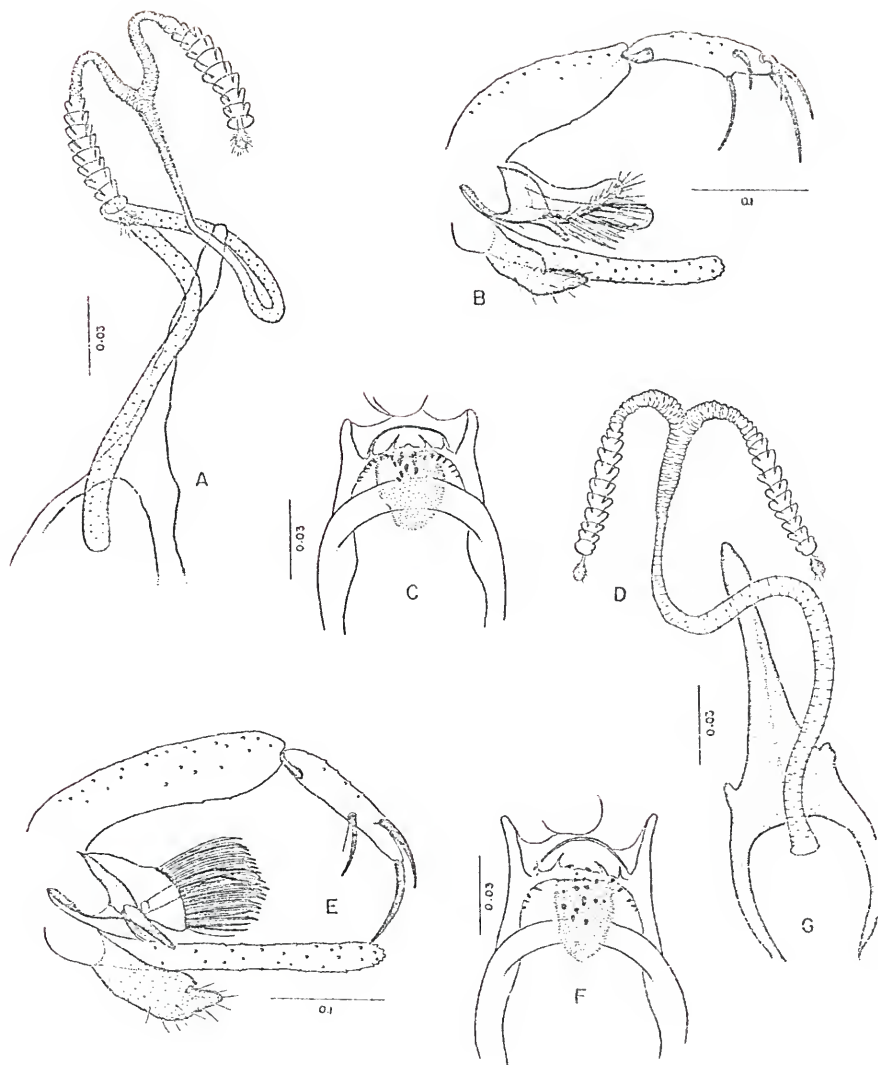


Figure 68

*Lutzomyia (P.) guyanensis* -- A. Male head, B. Male flagellomere II, C. Female head, D. Male flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, G. Body of spermatheca, H. Spermathecae, I. Female wing, J. Male wing, K. Female cibarium.

Male: Almirante, Bocas del Toro Prov., Panama

Female: Curiche, Choco Dept., Colombia

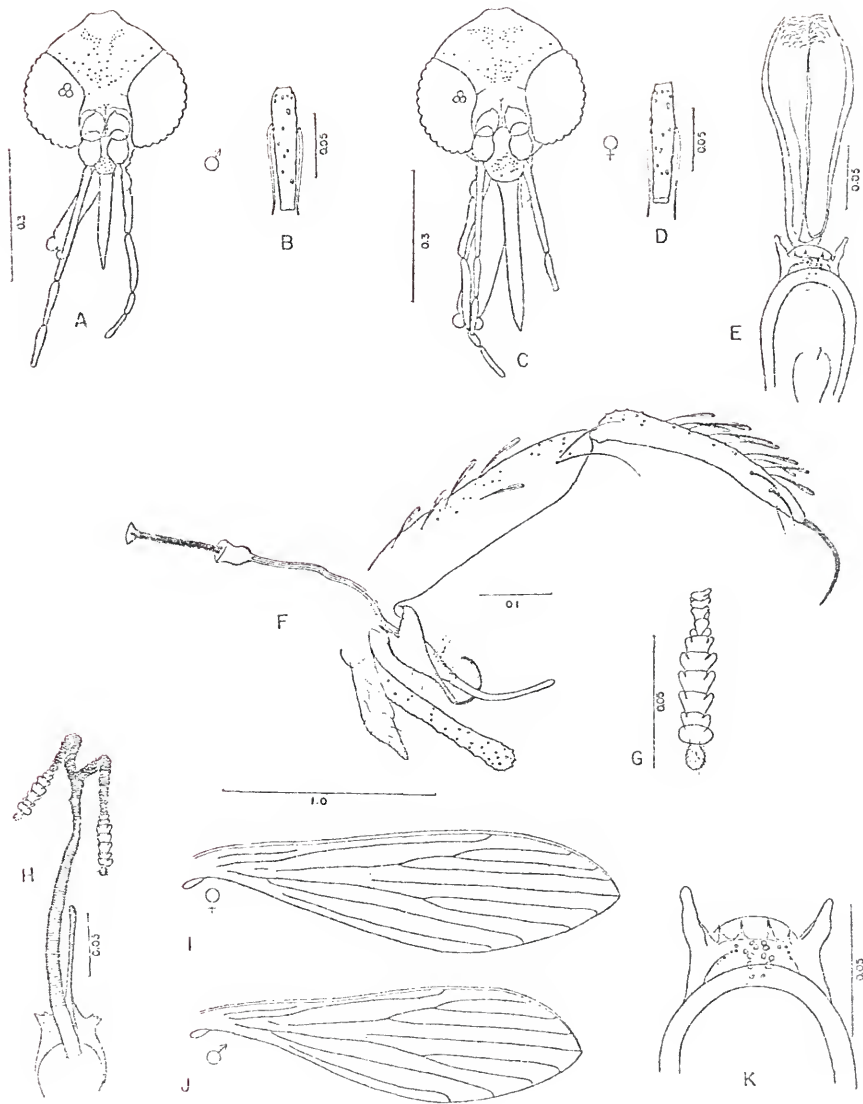


Figure 69

*Lutzomyia (P.) nocticola* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Aedeagus and paramere, G. Male genitalia, H. Spermathecae, I, Proximal end of genital pump, J. Genital pump and filaments, K. Female wing, L. Male wing, M. Female cibarium (all figures from Young, 1973).

Male: Rio Anori, Antioquia Dept., Colombia

Female: Same locality as male



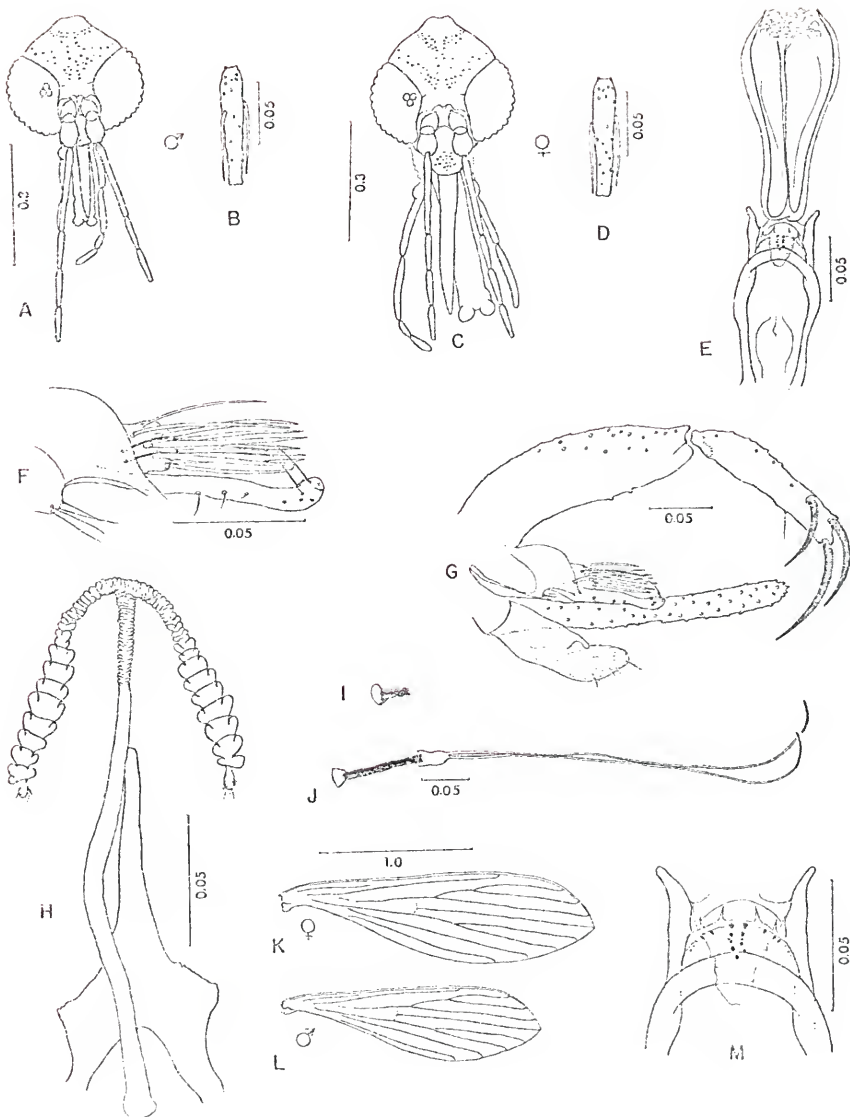


Figure 70

*Lutzomyia (P.) panamensis* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Genital filaments, G. Male Genitalia, H. Spermathecae, I. Female wing, J. Male wing, K. Female cibarium.

Male: Curiche, Choco Dept., Colombia

Female: Teresita, Choco Dept., Colombia

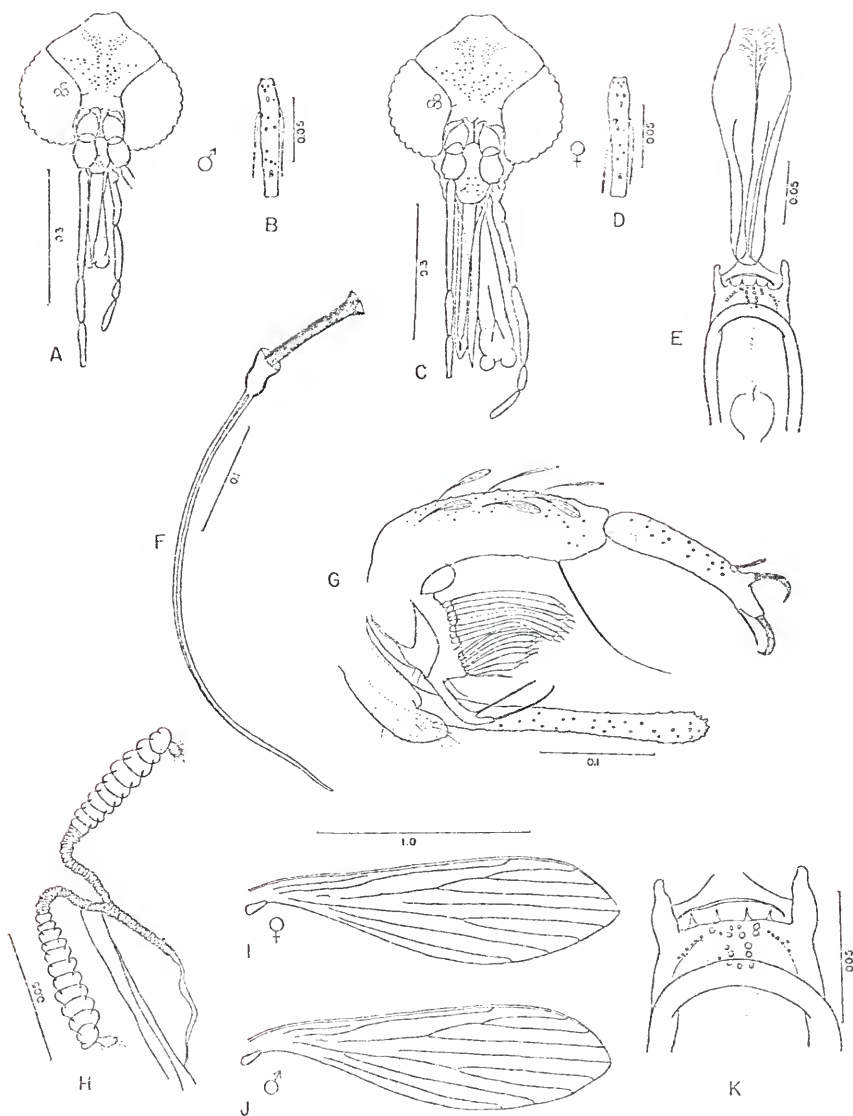
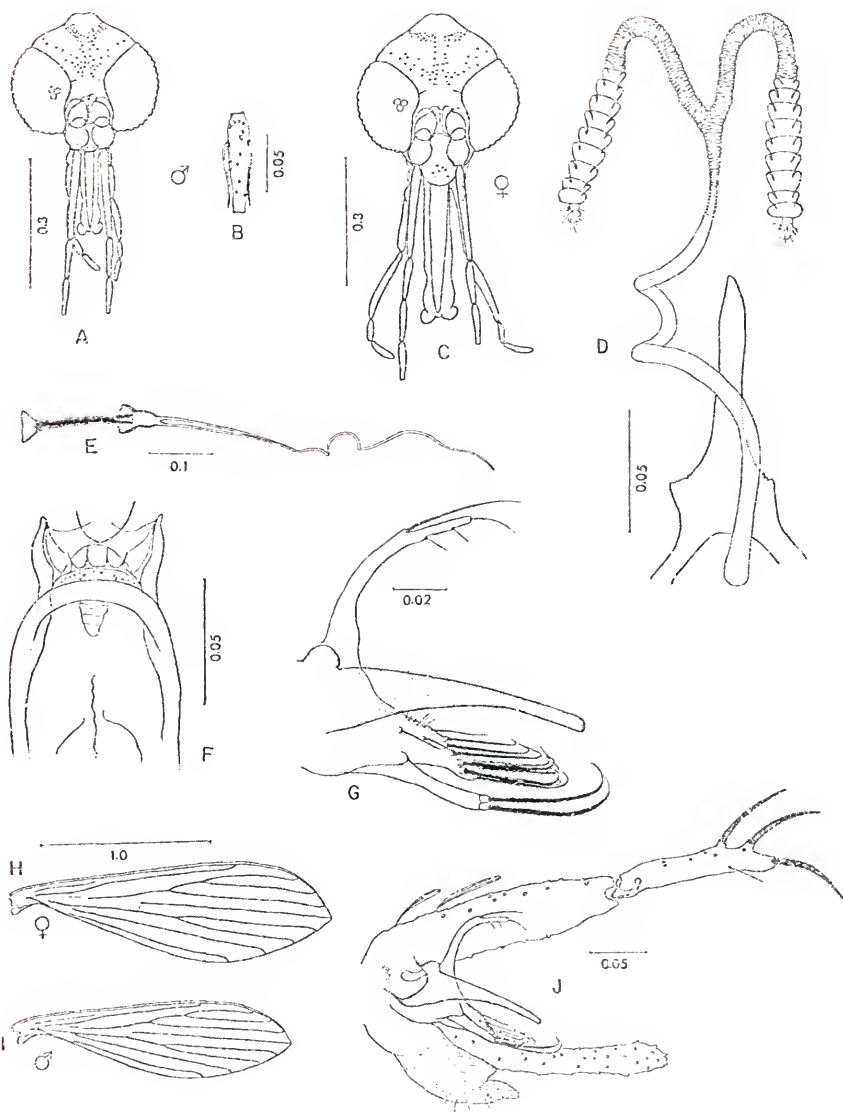


Figure 71

*Lutzomyia (P.) recurva* -- A. Male head, B. Male flagellomere II, C. Female head, D. Spermathecae, E. Genital pump and filaments, F. Female cibarium, G. Aedeagus and paramere, H. Female wing, I. Male wing, J. Male genitalia.

Male: Curiche, Choco Dept., Colombia

Female: Same locality as male



Vexator Group Theodor 1965

Defined and discussed by Fairchild and Hertig (1957) and Theodor (1965), this group is divided into 2 series -- the series *vexator* (4+ species, Central America and Nearctic Region) and the *peruensis* (14+ species, Central and South America). Most of the described species in the latter series occur in mountainous areas but a few including *L. hartmanni*, *L. sanguinaria*, and an undescribed Amazonian species from Ecuador inhabit lowland forests where they are strongly anthropophilic.

Forattini (1971a, 1973) places *hartmanni* and *sanguinaria* in the subgenus *Trichophoromyia* Barretto, genus *Psychodopygus* Mang., but this does not seem to reflect a natural arrangement. The females, unlike those of the *Trichophoromyia* spp. (in the sense of Sherlock and Guitton, 1970) have only 4 horizontal teeth in the cibarium and the males have 5 major spines on each style. The length of palp 5, variable in the *vexator* group spp., is relatively short in the *Trichophoromyia* spp.

The single known fossil phlebotomine in the New World, *L. paterna* (Quate, 1963), was discovered in Mexican amber (late Oligocene or early Miocene). It, a male, differs very little from some extant species in the *vexator* group (Quate, op. cit.). For the most part, the females in this group are keyed on the basis of external characters owing to similar cibaria and spermathecae, the latter being difficult to observe in permanent mounts. Not being completely satisfied with this key, I recommend that associated males be on hand before confirming specific identifications.

Keys to Species

Males

1. Coxite with 20+ setae forming a tuft or loosely arranged patch. . . 2  
  
Coxite with fewer than 5 setae at base. . . . . 4
2. Coxite setae loosely arranged. Genital filaments ca. 5X length of pump. Palpal segment 5 shorter than third. Flagellomere I shorter than or = to head height. . . . . *virrita* (Fig. 72)  
  
Coxite setae forming a compact tuft on a subcircular base. Genital filaments shorter than 4X length of pump. Palpal segment 5 longer than third. Flagellomere I longer than head height . . . . . 3
3. Palpal segment 5 shorter than segments 2 + 3. Paramere slender.  
  
Coxite tuft on a smaller subcircular base, its diameter less than greatest width of cercus . . . . . *strictivilla* (Fig. 76)  
  
Palpal segment 5 longer than segments 2 + 3. Paramere broader.  
  
Coxite tuft on a larger subcircular base, its diameter = to greatest width of cercus. . . . . *osornoi* (Fig. 74)
4. Aedeagus and genital filaments with blunt tips .*sanguinaria* (Fig. 75)  
  
Aedeagus and genital filaments with pointed tips. . . . . 5
5. Coxite tuft of 2-3 setae, one markedly thickened, over twice length of others and much wider at base. Style with all spines on apical half of structure . . . . . *scoreai* (Fig. 77)  
  
Coxite tuft of 3-5 setae, none markedly thickened as above. Style with basal spine usually on proximal half of structure. . . . . 6

6. Coxite tuft of 3-5 setae, one or more distinctly longer than others. Eyes separated by distance = to 5 or more facet diameters. Labrum or palp 5 shorter than 0.28 mm. . . . . *hartmanni* (Fig. 73)
- Coxite tuft of 3 setae subequal in length. Eyes closer together, separated by less than 4.5 facet diameters. Labrum or palp 5 longer than 0.30 mm . . . . . sp. of *Pichinde* (Fig. 78)

Females

1. Spermathecae carrot-shaped and large, each with a relatively broad terminal knob. Basitarsus of hind leg shorter than or = to length of hind femur . . . . . *sanguinaria* (Fig. 75)
- Spermathecae slender and smaller, each with a narrow, more protruding terminal knob. Basitarsus of hind leg longer than hind femur. . . 2
2. Labrum (< 0.43 mm long) shorter than head width. Combined length of palpal segments 1 + 2 + 3 shorter than 0.50 mm . . . . . 3
- Labrum (> 0.43 mm long) longer than head width. Combined length of palpal segments 1 + 2 + 3 over 0.50 mm . . . . . 4
3. Flagellomere I (> 0.40 mm long) much longer than labrum. Palpal segment 5 (> 0.25 mm long) = to or longer than segments 3 + 4 . . . . .
- . . . . . *strictivilla* (Fig. 76)
- Flagellomere I (< 0.40 mm long) shorter, = to or but slightly longer than labrum. Palpal segment 5 (< 0.25 mm long) shorter than segments 3 + 4 . . . . . *hartmanni* (Fig. 73)



4. Flagellomere I longer than labrum. . . . . *osornoi* (Fig. 74)

Flagellomere I shorter than labrum . . . . . 5

5. Genital fork stem markedly enlarged at tip . . . . *cirrita* (Fig. 72)

Genital fork stem subequal in width throughout . . . . .

. . . . . sp. of Pichinde (Fig. 78)

*scorzai*\* (Fig. 77)

88. *Lutzomyia cirrita*  
(Fig. 72)

*Lutzomyia cirrita* Young & Porter, 1974; 321 (♂ holotype, ♀, Rio Anori, Antioquia Dept., Colombia).

*Distribution:* Colombia (Antioquia, Valle).

*Material examined:* Colombia. 2 ♂♂, 9 ♀♀ (including holotype and allotype), type locality, other specifics by Young & Porter (1974). 1 ♂, Anchicaya Dam (Valle), flight trap, 10 June 1975, R.C.W.

*Discussion:* Other than biting man and being attracted to light traps (Young and Porter, op. cit.), this species is little known. The male, with the scattered coxite setae, is readily distinguished from other Colombian males in the *vexator* group.

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\*According to Ortiz (1965b), the length of palp 5 in Venezuelan *scorzai* females ranges from 0.28-0.33 mm. In the Colombian females it is generally shorter, ranging from 0.22-0.29 mm, average length 0.26 mm, n = 9. The length of this segment in *Lutzomyia* sp. of Pichinde ranges from 0.31-0.36 mm, average length 0.35 mm, n = 9 so that in Colombia, at least, this difference may be helpful in separating the females of *scorzai* and *Lutzomyia* sp. of Pichinde, both of which occur together in Valle Dept., near Cali.

89. *Lutzomyia hartmanni*  
(Fig. 73)

*Phlebotomus hartmanni* Fairchild & Hertig, 1957: 328 (♂ holotype, ♀, Cerro Campana, Panama Prov., Panama). Johnson & Hertig, 1961: 765 et seq. (rearing data). Ortiz & Alvarez, 1963b: 321 (listed). McConnell & Correa, 1964: 526 (infected with gregarines). Ortiz, 1965b: 25 et seq. (listed, cf. to *scorzai*, measurements). Hanson, 1968: 63 (larva cf. to *sanguinaria*, figs.).

*Lutzomyia hartmanni*: Barretto, 1962: 96 (listed). Barreto, 1969: 464 (Valle, Colombia). Christensen & Fairchild, 1971: 302 (Darien, Panama). Osorno et al., 1972a: 31 (Colombian records). Christensen, 1972a: 88 (listed). Young, 1973: 109 (Choco, Colombia). Young & Porter, 1974: 323 (cf. to *cirrita*).

*Psychodopygus hartmanni*: Forattini, 1971a: 105 (listed). Forattini, 1973: 123 et seq. (gen. review, figs.).

*Distribution*: Panama, Colombia (Antioquia, Choco, Valle), Ecuador.

*Material examined*: Colombia. 16 ♂♂, 8 ♀♀, Rio Anori (Antioquia), light traps, May 1970, C.H.P. 1 ♂, 8 ♀♀, same data but Sept. 1970, D.G.Y. 8 ♂♂, 1,066 ♀♀, Curiche (Choco), biting man, tree trunks, light, Malaise & Shannon traps, March-Dec. 1967, D.G.Y. 1 ♂, 114 ♀♀, same data but Alto Curiche (Choco), June-Nov. 1967. 2 ♂♂, 13 ♀♀, Teresita (Choco), biting man, tree trunks, Shannon traps, May-Oct. 1967, D.G.Y. 1 ♂, Rio Raposo (Valle), light trap, 4 May 1964, P. Barreto. 3 ♂♂, 6 ♀♀, Anchicaya Dam (Valle), light, flight, traps, tree trunks, 9-11 Aug. 1973, D.G.Y. & R.C.W. 8 ♀♀, 25 km E of Buenaventura (Valle), light traps, 12 Aug. 1973, D.G.Y. & R.C.W. Ecuador. 2 ♂♂, 3 ♀♀, 17 km E of Santa Domingo de los Colorados (Pichincha), light and flight traps, May 1976, D.G.Y., T. Rogers,

G. Fairchild. *Panama*. 1 ♂ (holotype no. 3997), type locality, light trap, 24 April 1952, F. Blanton. 1 ♀ (allotype no. 2904), type locality, Shannon trap, 10 Feb. 1951, M. Hertig et al. 2 ♂♂, 8 ♀♀, type locality; Almirante (Bocas del Toro); Canal Zone; Cerro Azul (Panama), various dates and collectors.

*Discussion:* At Curiche (Choco), this species represented nearly 20% (733 ♀♀) of all man-biting sand flies taken from April to November, 1967 (141 man hours). Only *L. panamensis* was more abundant in human bait collections, accounting for 46.5% (1751 ♀♀) of 3707 total females.

According to Hanson (1968), the larvae of *hartmanni* and *sanguinaria* are very close, differing only in the length of certain setae on the thorax and abdomen.

The breeding sites of the *hartmanni* immatures and the diurnal resting sites of the adults remain virtually unknown. At Curiche, we collected 1 ♂, 2 ♀♀ in tree buttresses but other resting sites were not sampled thoroughly.

90. *Lutzomyia osornoi*  
(Fig. 74)

*Phlebotomus osornoi* Ristorcelli & Van Ty, 1941: 260 (♀ holotype, Valle de Capuli, Narino Dept., Colombia). Rozeboom, 1947a: 177 (♂, descr.).

*Phlebotomus montoyai* Sherlock, 1962: 328 (♂, Chirristis, Municip. Tuquerres, Narino Dept., Colombia). Young & Porter, 1974: 324 (as synonym of *osornoi*, full refs.).

*Lutzomyia osornoi*: Barretto, 1962: 96 (listed). Young & Porter, 1974: 324 (full refs.). Osorno et al., 1972a: 79 (listed). Forattini, 1973: 213 et seq. (gen. review, figs.).

*Distribution:* Colombia (Narino).

*Material examined:* Colombia. 1 ♂, 1 ♀ (USNM), Chirristes (Narino)  
15 Aug. 1944, J.A. Montoya.

*Discussion:* See *L. strictivilla* n. sp.

91. *Lutzomyia sanguinaria*  
(Fig. 75)

*Phlebotomus sanguinarius* Fairchild & Hertig, 1957: 332 (♂ holotype, ♀, Almirante, Bocas del Toro Prov., Panama. Fairchild & Hertig, 1959: 122 (Central American records). Johnson & Hertig, 1961: 764 et seq. (rearing data). Johnson et al., 1962: 158 (infected with promastigotes). Ortiz & Alvarez, 1963b: 312 (listed). Hertig & McConnell, 1963: 93 et seq. (infected with *leishmania* in laboratory, fig.). McConnell, 1963: 124 et seq. (naturally infected with promastigotes). Shaw, 1964: 418 (feeding on sloths, Panama). McConnell & Correa, 1964: 526-528 (infected with gregarines, fungi, and nematodes). Thatcher & Hertig, 1966: 46 et seq. (hosts). Hanson, 1968: 74 et seq. (larva, pupa, descr., figs.). Thatcher, 1968a, 293 et seq. (hosts).

*Lutzomyia sanguinaria*: Barretto, 1962: 96 (listed). Johnson & Hertig, 1970: 281 et seq. (infected with *Leishmania* in laboratory). Tesh et al., 1971a: 153 (blood meals). Christensen et al., 1971: 118 (pyloric spicules). Christensen & Fairchild, 1971: 302 (Darien Prov., Panama). Chaniotis et al., 1971a: 344 et seq. (pop. dynamics, Panama). Chaniotis et al., 1971b: 415 et seq. (biting habits, Panama). Tesh et al., 1972: 90 et seq. (blood meals). Christensen, 1972a: 88 (listed). Chaniotis et al., 1972: 95 (resting sites). Young, 1973: 109 (Choco, Colombia). Christensen & Herrer, 1973: 579 et seq. (collecting data, as

probable vector of *Leishmania*). Chaniotis, 1974b: 501 (keyed).  
Chaniotis & Correa, 1974: 115 (collecting data). Young & Porter, 1974: 223 (cf. to *cirrita*). Ward & Killick-Kendrick, 1974: 214 (mention).  
Lewis, 1975a: 501 et seq. (mouthpart morphol.). Rutledge & Mosser, 1975: 410 (mention). Christensen & Herrer, 1976: 299 (as host for *Endotrypanum schaudinni*). Herrer & Christensen, 1976c: 62 (collecting data, Panama). Herrer & Christensen, 1976b: 57-58 (on man, horse, and sloths). Miles et al., 1976: 532 (mating aggregation, Panama). Zimmerman et al., 1977: 575 (egg, descr., figs.).

*Psychodopygus sanguinarius*: Forattini, 1971a: 105 (listed).  
Forattini, 1973: 123 et seq. (gen. review, refs., figs.).

*Distribution*: Honduras, Costa Rica, Panama, Colombia (Choco, Valle).

*Material examined*: Colombia. 7 ♂♂, 568 ♀♀, biting man, light, Shannon, Malaise traps, tree trunks, Curiche (Choco), April-Oct. 1967, D.G.Y. 1 ♂, 81 ♀♀, Alto Curiche (Choco), biting man, light traps, July-Nov. 1967. 3 ♂♂, 2 ♀♀, Teresita (Choco), light, Malaise traps, tree trunks, March, May-July 1967, D.G.Y. 1 ♀, Anchicaya Dam (Valle), light trap, 11 Aug. 1973, D.G.Y. & R.C.W. Panama. 4 ♂♂, 9 ♀♀, laboratory reared at GML.

*Discussion*: A highly anthropophilic species which has been incriminated as a vector of leishmaniasis in Panama (Christensen & Herrer, 1973), *L. sanguinaria* was the third most common sand fly in human bait collections at Curiche from April to Nov., 1967. Nearly 12% (432 ♀♀) of 3763 females taken during this time belonged to this taxon.

The *sanguinaria* female is easily identified by the characteristic spermathecae (Fig. 75H), the structure of which resembles those of the *verrucarum* group species (Theodor, 1965). For further information on the

habits and disease relationships, the reader is directed to the above references, especially Forattini (1973) who reviews most of them prior to 1972.

92. *Lutzomyia scorzai*  
(Fig. 77)

*Phlebotomus scorzai* Ortiz, 1965b: 28 (♂ holotype, ♀, Rancho Grande, Aragua State, Venezuela). Scorza et al., 1967: 191 et seq. (listed, ♂, ♀ keyed). Leon, 1969: 31 (listed).

*Lutzomyia scorzai*: Forattini, 1971a: 100 (listed). Martins & Morales, 1972: 366 (listed). Young & Porter, 1974: 323 (cf. to *cirrita*). Forattini, 1973: 213 et seq. (gen. review, figs.).

*Distribution*: Colombia (Cauca, Valle), Venezuela.

*Material examined*: Colombia. 1 ♂ (UV), La Penude del Perro, 2180 m near El Tambo (Cauca), light trap, 11-12 May 1967, P. Barreto. 9 ♂♂, 1 ♀, W of Cali at television tower (Valle), light trap, 9 Aug. 1973, D.G.Y., R.C.W., & S. Ayala. 2 ♂♂, 6 ♀♀ (UV), Pichinde 1537 (Valle), light traps, Feb.-March 1967, P. Barreto. 2 ♂♂, 1 ♀, same data but 2 Aug. 1973, D.G.Y. & R.C.W. 1 ♂, same data but 9 Feb. 1975, J. Browne. 1 ♂, 1 ♀, Anchicaya Dam, 400 m (Valle), light trap, 28 Jan. 1975, J. Browne. Venezuela. 1 ♂, Rancho Grande (Aragua), in tree buttress, 29 April 1948, H. Trapido.

*Discussion*: A topotype of *L. scorzai*, listed above, is somewhat aberrant with only 1 small setae at the base of the coxite instead of 2 or 3. The Colombian specimens agree more closely with Ortiz's description of this species and I am treating them as conspecific for the present.

According to Ortiz (1965b), the *scorzai* males have 2-3 (usually 2) basal coxite setae, one of which is markedly enlarged. The Colombian males also have an enlarged seta plus at least 2 other smaller setae at the coxite base. The parameres are generally similar although those of the Colombian males are slightly more clubbed apically and the ventral margin, below the aedeagus, is less acute. Other character states of the males, and seemingly all those of the females, are quite similar except for the longer palp 5 of some of the *scorzai* females from Venezuela.

In Colombia, *L. scorzai* occurs with *Lutzomyia* sp. of Pichinde at Pichinde (Valle) and with *L. hartmanni*, *L. sanguinaria*, and *L. cirrita* at Anchicaya Dam (ca. 400 m above sea level). Both the *scorzai* male and female, the only specimens available from the latter site, are smaller than any of those from higher localities in Valle and Cauca Depts. (1200-2180 m). The wing length of the male = 2.1 mm; that of the female = 2.5 mm as opposed to 2.6-3.0 mm for the others from higher elevations. A similar variation in size as related to altitude is that observed in specimens of *B. galindoi* discussed earlier. Thus far, *L. scorzai* has been taken only in light traps.

I associated the sexes of *L. scorzai* on the basis of several features, notably the length of palp 5 which ranges from 0.20 to 0.31 mm in males; 0.22 to 0.29 mm in females (n = 10 for each sex). The interocular distance is rather narrow when compared to that of sympatric species in the *vexator* group. Light trap collections near Cali, where a large television tower is situated, yielded *scorzai* males and females but no others in the *vexator* group.

The *scorzai* male, characterized by the enlarged seta of the coxite tuft, is readily distinguished from the males of *hartmanni*, *Lutzomyia* sp.

of Pichinde, and others by this character and by others in the key.

The females of *scorzai*, *hartmanni*, and sp. of Pichinde are difficult to separate, the spermathecae, cibaria, and palpal proportions being of little diagnostic value. I therefore must rely on direct measurements to distinguish them. The labrum of *hartmanni* females ranges from 0.32 to 0.42 mm in length (n = 43 from various localities in Panama and Colombia). Flagellomere I is shorter than 0.40 mm. Both structures are longer in *scorzai* females, the labrum ranging from 0.47 to 0.54 mm in length; the first flagellomere 0.44 to 0.50 mm long.

The females of *scorzai* and sp. of Pichinde are nearly indistinguishable, only the length of palp 5 being helpful in diagnosis (see footnote on p. 369).

A male and female of *scorzai* from west of Cali at the television tower locality are described as follows.

*Male*: Wing length 2.62; width 0.80. Except for middle part of pleuron which is paler, whole insect well pigmented, dark. Head height 0.40; width 0.39. Eyes separated by 0.12 or by distance = to 6.3 facet diameters. Flagellomere I (0.47 long), 1.2X length of II + III; ascoids simple, short, those on flagellomere II ending near middle, on all flagellomeres except last. Length of palpal segments: 1 (0.05), 2 (0.15), 3 (0.16), 4 (0.08), 5 (0.21); palpal sensilla (ca. 14) on distal two-thirds of segment 3. Labrum length 0.29. Cibarium with 15+ dot like vestiges of teeth; chitinous arch indiscernible in middle; pigment patch invisible. Pharynx 0.18 long, unarmed. Pleura with 13 upper and 4 lower episternal setae. Length of wing vein sections: *Alpha* (0.75), *beta* (0.27), *delta* (0.10), *gamma* (0.29). Length of femora, tibia, and basitarsi:



Foreleg, 0.93, 1.41, 1.02; midleg, 0.89, 1.60, 1.10; hindleg, 1.00, 1.90, 1.20. Abdominal sternite 2 entire, others (3-5 at least) with barely visible, paired circular openings laterally. Genitalia: Style 0.20 long, with 5 major spines, all beyond middle of structure, no subterminal seta. Coxite (0.32 long x 0.06 wide) with a basal tuft of 3 setae, one much thicker and longer than others, its length exceeding width of coxite. Paramere simple as figured. Aedeagus subtriangular, pointed at tip. Lateral lobe 0.30 long. Genital pump 0.14 long, each filament 0.39 long or nearly 2.8X length of pump. Cercus as shown.

*Female*: Wing length 3.06; width 1.03. Coloration as in ♂. Head height 0.52; width 0.47. Eyes separated by 0.16 or by distance = to 8 facet diameters. Flagellomere I (0.47 long), nearly 1.2X length of II + III; ascoids as in ♂ but slightly longer. Length of palpal segments: 1 (0.07), 2 (0.24), 3 (0.26), 4 (0.09), 5 (0.24); palpal sensilla (22+) as in o. Labrum 0.52 long. Cibarium with 4 sharp, equidistant horizontal teeth, ca. 14 vertical teeth, some larger than others; chitinous arch hardly visible, apparently incomplete; pigment patch faintly pigmented. Pharynx 0.27 long, unarmed. Pleura with 20 upper and 5 lower episternal setae. Length of wing vein sections: *Alpha* (0.88), *beta* (0.37), *delta* (0.18), *gamma* (0.33). Length of femora, tibiae, and basitarsi: Foreleg, 1.13, 1.50, 1.10; midleg, 1.01, 1.79, 1.16; hindleg, 1.15, 2.11, 1.35. Abdominal sternites as in ♂. Tergite 8 with 8 setae on each side. Spermathecae cylindrical as shown, segmented, ca. one-third length of individual ducts but longer than common duct. Cerci unremarkable.

93. *Lutzomyia strictivilla* n. sp.  
(Fig. 76)

*Male* (holotype): Wing length 2.10; width 0.67. Whole insect dusky except for darker head, part of mesonotum, procoxae, and abdominal tergites 1-3. Head height 0.42; width 0.37. Eyes separated by 0.12 or by distance = to 6 facet diameters. Flagellomere I (0.50 long), slightly longer than II + III; ascoids simple, short, those on II not extending beyond middle of structure, on all flagellomeres except last. Length of palpal segments: 1 (0.04), 2 (0.13), 3 (0.17), 4 (0.09), 5 (0.25); palpal sensilla (ca. 20), on distal two-thirds of segment 3. Labrum 0.26 long. Cibarium with ca. 20 vestigial teeth; pigment patch slender, it and chitinous arch nearly invisible, the latter seemingly complete. Pharynx 0.23 long, unarmed. Pleura with 11-12 upper and 5-6 lower episternal setae. Length of wing vein sections: *Alpha* (0.67), *beta* (0.17), *delta* (0.22), *gamma* (0.40). Length of femora, tibiae, and basitarsi: Foreleg, 1.12, 1.71, 1.20; midleg, 1.0, 1.94, 1.32; hindleg, 1.23, 2.33, 1.47. Abdominal sternites entire, no openings visible. Genitalia: Style 0.24 long, with 5 major spines, basal pair on different levels, not quite paired, no subterminal bristle. Coxite (0.41 long x 0.08 wide), with basal tuft of ca. 25 slender setae inserted on a circular, raspberry-like base. Paramere simple, rather slender as shown. Aedeagus subtriangular, pointed at tip. Lateral lobe 0.33 long. Genital pump 0.12 long, each filament very thin, 0.43 long or nearly 3.6X length of pump. Cerci unremarkable.

*Female* (allotype): Wing length 2.30; width 0.78. Coloration as in male. Head height 0.47; width 0.40. Eyes separated by 0.13 or by distance = to 6.3 facet diameters. Flagellomere I (0.41 long), slightly

longer than II + III; ascoids simple, longer than in ♂ but not reaching end of flagellomere II, on all but last flagellomere. Length of palpal segments: 1 (0.05), 2 (0.15), 3 (0.19), 4 (0.09), 5 (0.27); palpal sensilla as in ♂. Labrum 0.32 long. Cibarium with 4 straight, equidistant horizontal teeth, ca. 15 small vertical teeth in an irregular transverse row; pigment patch slender, wider near vertical teeth; chitinous arch complete but hardly visible in middle. Pharynx 0.21 long. Pleura with 10-11 upper and 3-4 lower episternal setae. Length of wing vein sections: *Alpha* (0.77), *beta* (0.16), *delta* (0.33), *gamma* (0.37). Length of femora, tibiae, and basitarsi: Foreleg, 0.98, 1.40, 0.95; midleg, 0.88, 1.50, 1.05; hindleg missing. Abdominal sternites as in ♂. Tergite 8 with 2-5 setae on each side. Spermathecae and ducts as shown. Cerci unremarkable.

*Distribution:* Colombia (Antioquia).

*Material examined:* Colombia. ♂ (holotype no. 577), Rio Anori (Antioquia), human bait, 5 March 1971, R. Pinger. ♀ (allotype no. 578), same data but 12-13 Aug. 1971, C.H.P. 4 ♂♂, 5 ♀♀ (paratypes nos. 579-587), same data as holotype. 2 ♀♀ (paratypes nos. 588-589), same data as allotype. 2 ♂♂ (paratypes nos. 593-594), type locality, tree trunk, 14 April 1971, C.H.P. 1 ♂ (paratype no. 590), type locality, human bait, 30 March 1971, C.H.P. 1 ♀ (paratype no. 591), same data but 21 July 1971. 1 ♂ (paratype no. 595), same data but 16 Sept. 1970.

*Discussion:* I associated the sexes of *L. strictivilla* on the basis of nonsexual characters, especially the degree and distribution of body pigmentation and the length of palp 5 and flagellomere I.

The female closely resembles that of *L. hartmanni* which also occurs at the Rio Anori locality but palp 5 is longer, ranging from 0.27-0.34 mm

(n = 7) as opposed to less than 0.21 mm for *hartmanni* (n = 16 from various localities including Rio Anori). Similarly, flagellomere I is shorter in *hartmanni* females, not exceeding 0.37 mm in 18 ♀♀ measured; whereas in *strictivilla* females it ranges from 0.41-0.48 mm in length (n = 7).

Of the *vexator* group species, *L. strictivilla* most closely resembles *L. osornoi* but that species is very large, the wing being 3.0 mm or longer in both sexes. In contrast to the *osornoi* male, *L. strictivilla* has relatively slender parameres, the coxite tuft is smaller and consists of fewer setae.

Other than size differences, I am unable to separate the females of *strictivilla* and *osornoi*. The labrum of the latter exceeds 0.47 mm in length; whereas in *strictivilla* females, the labrum is less than 0.39 mm long (0.32-0.38 mm, n = 7).

Future studies based on material from other localities may reveal that these taxa are distinct as subspecies or geographic variants but until, or unless, evidence to support this becomes available, I will continue to treat them as distinct species.

The specific name means "vile woman" and refers to the man-biting habit of the females, Dr. C.H. Porter having collected over 20 females attacking man at Rio Anori in 1970 and 1971 (pers. comm.).

94. *Lutzomyia* sp. of Pichinde  
(Fig. 78)

*Distribution:* Colombia (Valle).

*Material examined:* Colombia. 6 ♂♂, 2 ♀♀, ca. 10 km W of Cali (1750 m) (Valle), tree trunks, rock crevice, 31 July 1973, D.G.Y. & R.C.W. 3 ♂♂, 1 ♀, same data but 2 Aug. 1973. 1 ♂, 7 ♀♀, same locality

but light trap, 2 Aug. 1973. 2 ♂♂, ca. 15 km SW of Cali near Rio Pance (1600 m) (Valle), tree trunk, 7 Aug. 1973, D.G.Y. & S. Ayala.

*Discussion:* Owing to the uncertain status of this taxon, I prefer to give it an informal name, hoping that future studies will firmly establish its position as a distinct species or as a geographic variant of *L. hartmanni*.

*Lutzomyia* sp. of Pichinde is larger than *hartmanni*, possibly reflecting altitudinal differences as noted for *B. galindoi* and *L. scorzai*. Thus far, specimens of sp. of Pichinde have been taken only near Cali (Valle) above 1200 m. It has not been determined whether or not the females are anthropophilic. The coxite tuft of the male consists of 3 setae, all subequal in size, and palp 5 is always longer than palp 3. Both sexes were collected together in forests on tree trunks, in a rock crevice and once in a light trap.

*Lutzomyia hartmanni*, an anthropophilic species most common in the lowlands of Colombia, has been taken as high as 950 m at Cerro Campana, Panama Prov., Panama --- the type locality. Specimens from there, including the holotype and allotype, are larger than those from the lowlands but do not differ in structure. One seta of the coxite tuft is larger than the others. Palp 5 is variable, being less than, equal to, or but slightly longer than palp 3. This species is rarely found resting on tree trunks.

A description of *Lutzomyia* sp. of Pichinde is given below. Both the male and female were taken together on a tree trunk near Pichinde on 31 July 1973.

*Male* (no. 598): Wing length 3.09; width 0.98. Head, mesonotum and genitalia well pigmented, contrasting with rest of insect which is faintly pigmented. Head height 0.49; width 0.44. Eyes narrowly separated,

interocular distance = 0.76 or 3.9 facet diameters. Flagellomere 1 (0.50 long), 1.35X length of II + III; ascoids simple, tips extending beyond middle of II, on all flagellomeres except last. Length of palpal segments: 1 (0.06), 2 (0.18), 3 (0.22), 4 (0.11), 5 (0.35); palpal sensilla (ca. 15) on distal two-thirds of segment 3. Labrum length 0.35. Cibarium with ca. 20 small remnants of teeth. Pigment patch slender, hardly visible; chitinous arch indefinite. Pharynx 0.24 long, unarmed. Pleura with 15 upper and 6 lower episternal setae. Length of wing vein sections: *Alpha* (0.84), *beta* (0.35), *delta* (0.26), *gamma* (0.38). Length of femora, tibia, and basitarsi of slide no. 600: Foreleg, 1.07, 1.83, 1.24; midleg, 1.02, 1.93, 1.34; hindleg, 1.20, 2.30, 1.57. Abdominal sternite 2 not visible (other ♂♂ have paired lateral openings). Genitalia: Style 0.20 long, with 5 major spines, the most basal on proximal one-half of structure, no subterminal seta. Coxite (0.36 x 0.08 wide) with 3 monomorphic, thin setae at base, none longer than greatest width of coxite. Aedeagus subtriangular, pointed at tip. Lateral lobe 0.31 long. Genital pump 0.15 long, each filament 0.51 long or 3.4X length of pump. Cercus as shown.

*Female* (no. 599): Wing length 3.29; width 1.1. Coloration as in ♂. Head height 0.60; width 0.51. Eyes separated by 0.13 or by distance = to 6.2 facet diameters. Flagellomere I (0.53 long), 1.32X length of II + III; ascoids as in ♂ but slightly longer as shown. Length of palpal segments: 1 (0.07), 2 (0.28), 3 (0.31), 4 (0.13), 5 (0.35); palpal sensilla as in ♂. Labrum 0.59 long. Cibarium with 4 sharp equidistant teeth, ca. 16 vertical teeth subequal in size; pigment patch subtriangular, moderately infuscated; chitinous arch most noticeable at sides, but complete. Pharynx 0.30 long, unarmed. Pleura with 22 upper and 5 lower

episternal setae. Length of wing vein sections: *Alpha* (0.98), *beta* (0.32), *delta* (0.32), *gamma* (0.40). Length of femora, tibiae, and basitarsi: Foreleg, 1.24, 1.91, 1.27; midleg, 1.15, 2.11, 1.40; hindleg, 1.35, 2.45, 1.40. Abdominal sternite 2 entire (other ♀♀ show barely visible paired lateral openings). Tergite 8 with 1 seta on each side (other ♀♀ have 4+ setae on each side). Spermathecae and ducts as shown. Cerci normal.

Figure 72

*Lutzomyia cirrita* -- A. Male head, B. Female wing, C. Male wing, D. Female head, E. Female cibarium and pharynx, F. Male genitalia, G. Male flagellomere II, H. Female flagellomere II, I. Aedeagus and paramere, J. Genital pump and filaments, K. Spermathecae.

Male: Rio Anori, Antioquia Dept., Colombia

Female: Same locality as male



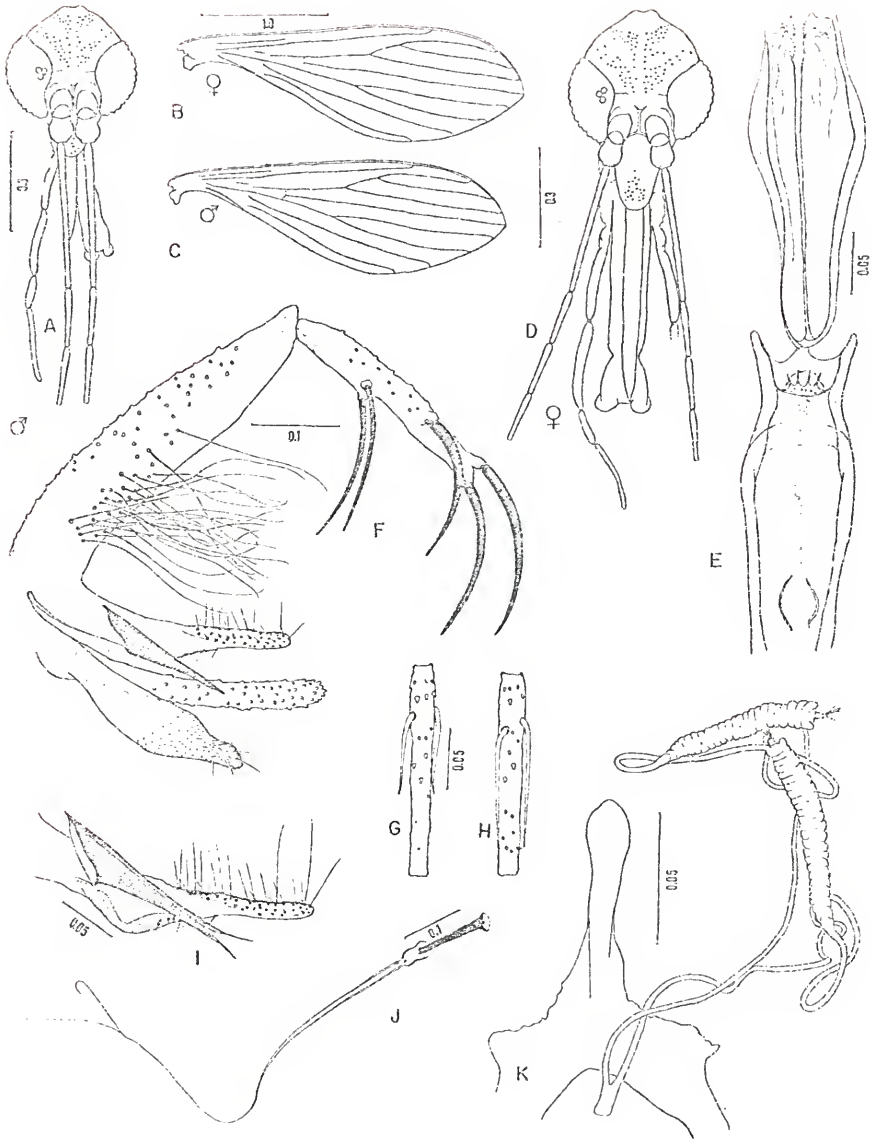


Figure 73

*Lutzomyia hartmanni* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Genital pump and filaments, same scale as Fig. 73G, G. Male genitalia, H. Spermathecae, I. Female wing, J. Male wing, K. Female cibarium.

Male: Valle Dept., Colombia

Female: Curiche, Choco Dept., Colombia

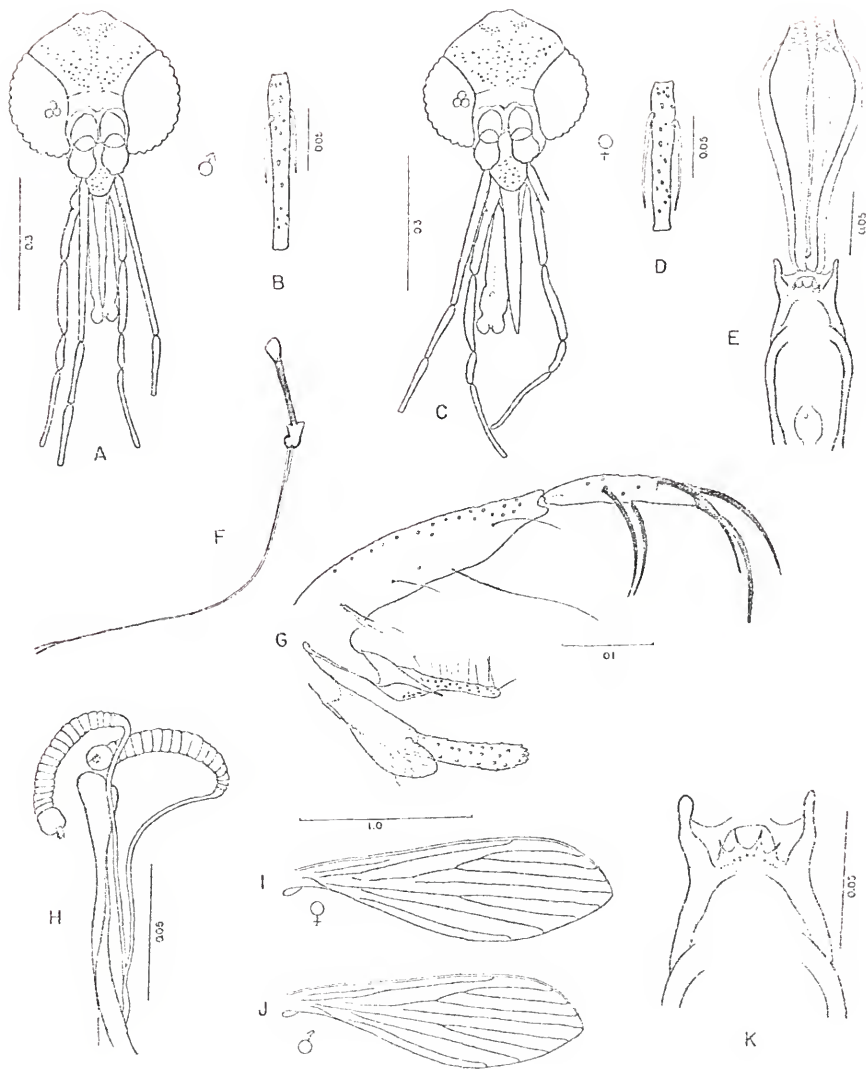


Figure 74

*Lutzomyia osornoï* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Genital pump and filaments, G. Spermathecae, H. Body of spermatheca, I. Male genitalia, J. Genital pump, K. Aedeagus and paramere, L. Female wing, M. Male wing.

Male: Chirristis, Nariño Dept., Colombia

Female: Same locality as male

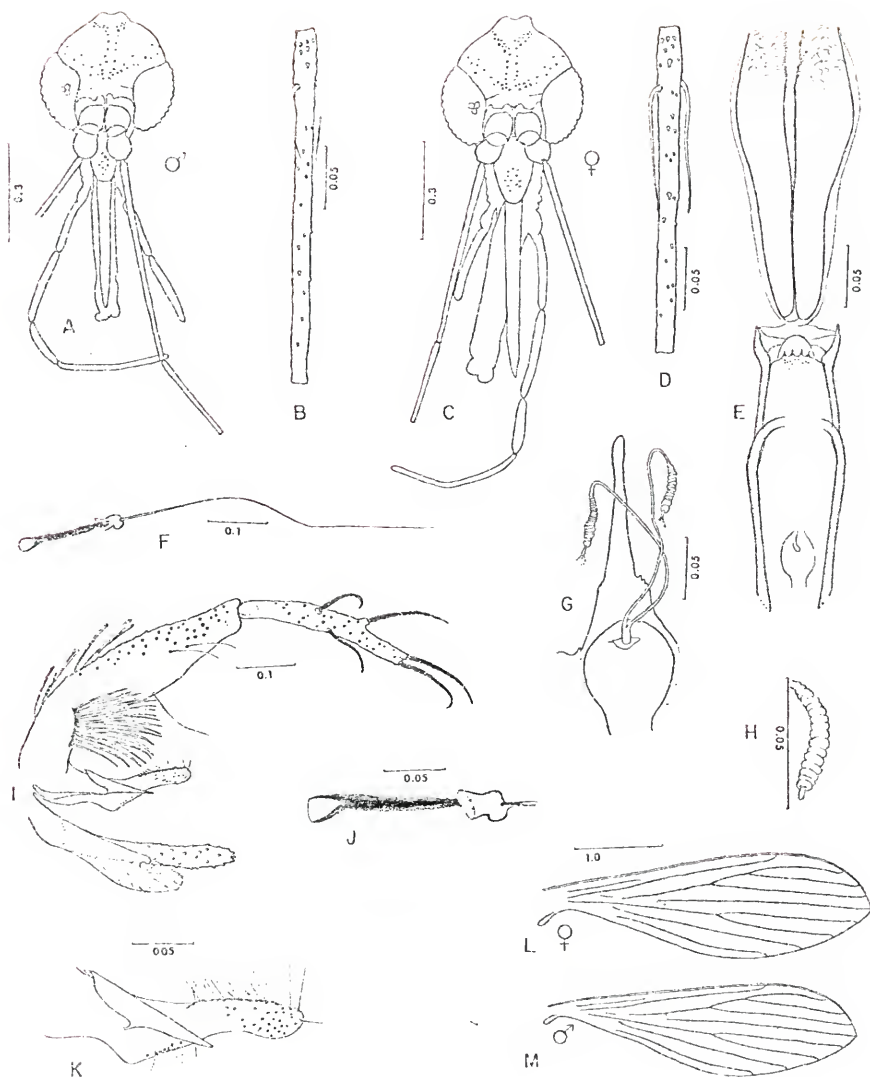


Figure 75

*Lutzomyia sanguinaria* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Genital pump and filaments, same scale as Fig. 75G, G. Male genitalia, H. Spermathecae, I. Female wing, J. Male wing, K. Female cibarium.

Male: Panama Canal Zone

Female: Curiche, Choco Dept., Colombia

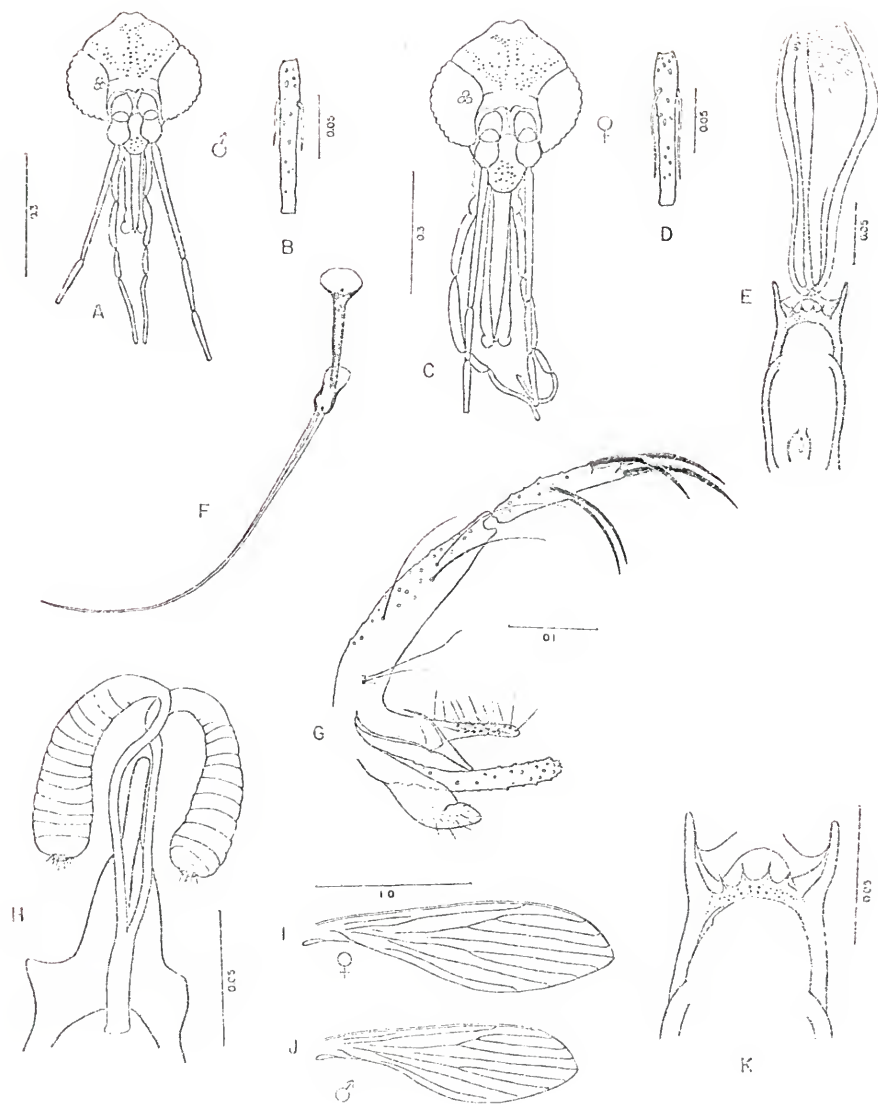


Figure 76

*Lutzomyia strictivilla* -- A. Male head, B. Female wing, C. Male wing, D. Female head, E. Male genitalia, F. Female cibarium, G. Male flagellomere II, H. Female flagellomere II, I. Spermatheca.

Male: Rio Anori, Antioquia Dept., Colombia  
Female: Same locality as male



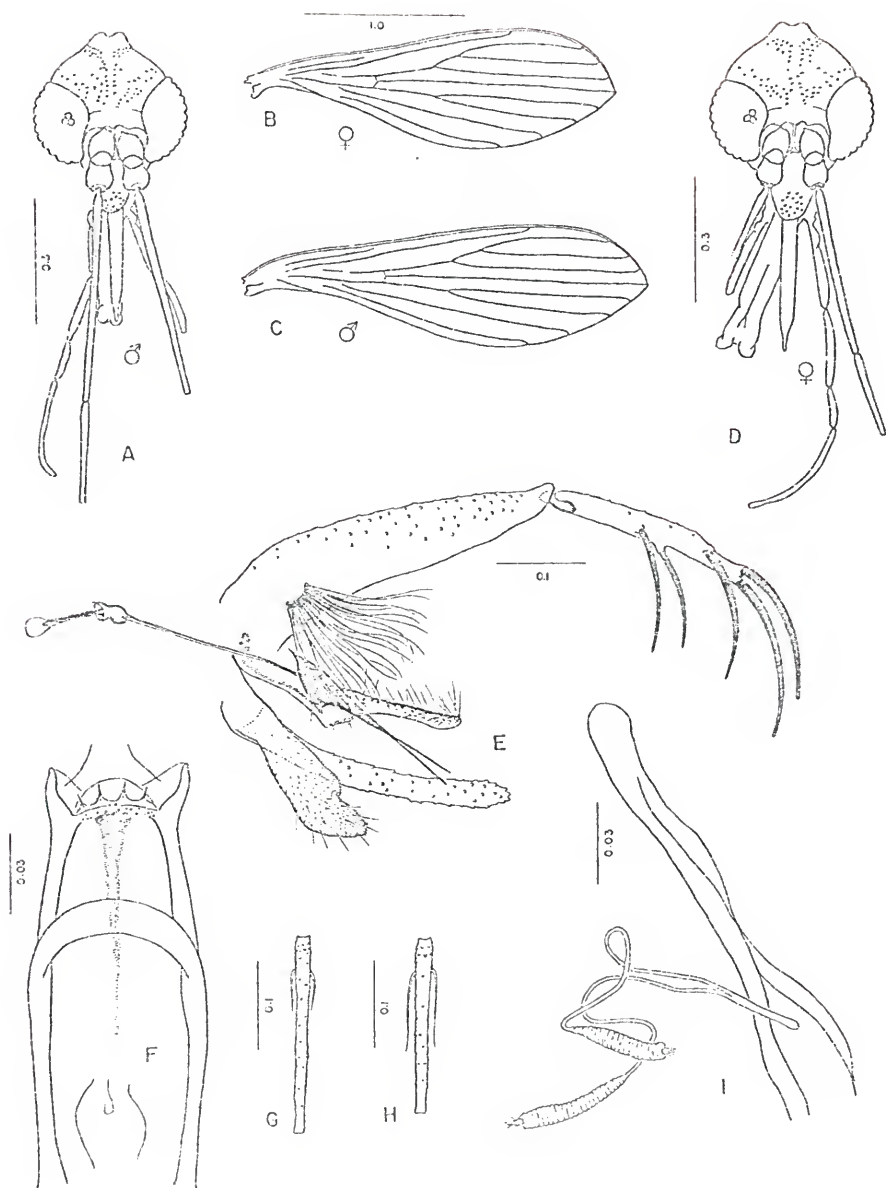


Figure 77

*Lutzomyia scorzai* -- A. Female head, B. Female flagellomere II,  
C. Genital pump, D. Female cibarium, E. Male genitalia, F. Male wing,  
G. Female wing, H. Male wing, I. Spermathecae.

Male: East of Salidito, Valle Dept., Colombia

Female: Same locality as male

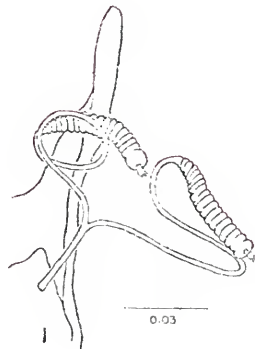
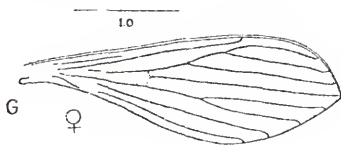
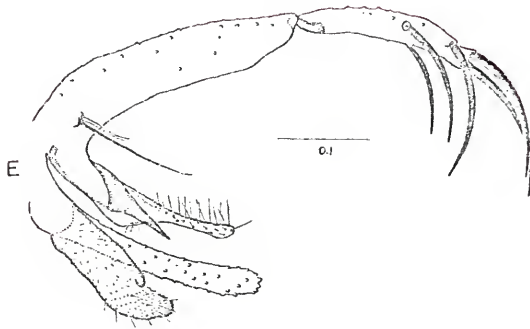
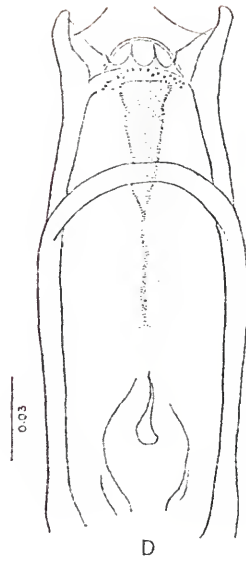
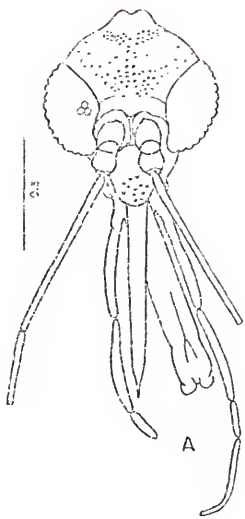
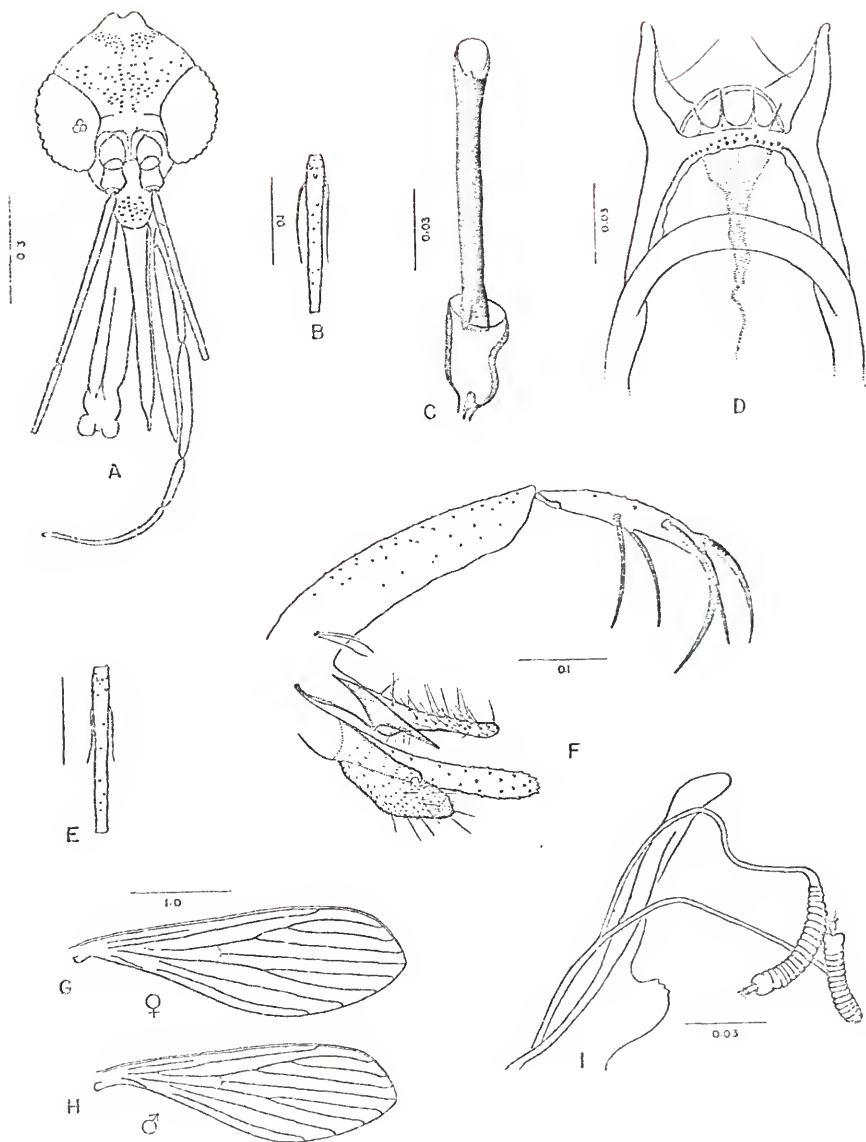


Figure 78

*Lutzomyia* sp. of Pichinde -- A. Female head, B. Female flagellomere II, C. Genital pump, D. Female cibarium, E. Male flagellomere II, F. Male genitalia, G. Female wing, H. Male wing, I. Spermathecae.

Male: Pichinde, Valle Dept., Colombia

Female: Same locality as male



Cayennensis Group Theodor, 1965

The *cayennensis* group with over 17 species and subspecies, depending on author, corresponds to the subgenus *Micropygomyia* Barretto, 1962. The species are divided into 3 subgroups -- the series *cayennensis*, *chiapanensis*, and *atroclavata* (Lewis et al., 1978).

There is circumstantial and direct evidence indicating that some (and probably most) of these species feed on cold-blooded vertebrates (Fairchild, 1955; Williams et al., 1965; Lewis, 1975a).

Four species in the *cayennensis* group are presently known to occur in Colombia.

Keys to Species

Males

1. Coxite with a tuft or group of 4+ setae . . . . . 2  
Coxite without nondeciduous setae . . . . . 3
2. Coxite tuft of 4 strong setae . . . . . *L. atroclavata* (Fig. 81)  
Coxite tuft of 7-11 rather slender, straight setae . . . . .  
. . . . . *venezuelensis* (Fig. 82)
3. Profemur shorter than protibia. Cibarium with a comb-like row of  
vestigial horizontal teeth, similar to Fig. 79J. Pleura pale. Wing  
broader . . . . . *cayennensis* (Fig. 79)  
Profemur longer than protibia. Cibarium without horizontal teeth in  
a comb-like row. Pleura dark. Wing very slender . . . . .  
. . . . . *micropyga* (Fig. 80)

Females

1. Cibarium with a comb-like row of 12+ horizontal teeth . . . . .  
. . . . . *cayennensis* (Fig. 79)

Cibarium with fewer than 6 horizontal teeth, not in a comb-like  
row . . . . . 2

2. Profemur longer than protibia. Pharynx shorter with inconspicuous  
posterior spines. Pleura as dark as mesonotum. Cibarium with  
protuberance between inner pair of horizontal teeth . . . . .  
. . . . . *micropyga* (Fig. 80)

Profemur shorter than protibia. Pharynx longer and wider with  
prominent spines and transverse ridges. Pleura obviously paler than  
mesonotum. Cibarium without a protuberance between inner pair of  
horizontal teeth. . . . . 3

3. Cibarium with very small horizontal teeth. Pigment patch rather  
broad . . . . . *atroclavata* (Fig. 81)

Cibarium with much larger horizontal teeth. Pigment patch more  
slender . . . . . *venezuelensis* (Fig. 82)

Series *cayennensis*

95. *Lutzomyia cayennensis*  
(Fig. 79)

*Phlebotomus cayennensis* Floch & Abonnenc, 1941a: 13 (♂ holotype,  
Montjoly, Cayenne, French Guiana). Barretto, 1947: 192 (refs.).  
Fairchild & Hertig, 1948b: 460 et seq. (♂, ♀, redescr., figs., refs.,

Panama). Floch & Abonnenc, 1952: 37, 46 (♂, ♀, keyed), 138-142 (♂, ♀, redescr., figs.). Pifano & Ortiz, 1952: 143, 148 (♂, ♀, keyed, Venezuela). Rosabal, 1954: 10 et seq. (♂, redescr., figs., Costa Rica). Fairchild & Hertig, 1959: 121-123 (distrib.). Arzube, 1960: 155 (Ecuador). Johnson & Hertig, 1961: 773 (rearing data). Pifano et al., 1962: 385, 388 (♂, ♀, keyed), 400-401 (♂, ♀, redescr., figs., refs.). Rosabal & Trejos, 1964: 167 (El Salvador). Williams et al., 1965: 70 (reptile blood in gut). Ortiz, 1965a: 205 et seq. (♀, keyed, cf. to *yencanensis*). Osorno et al., 1967: 28 (Colombian record). Hanson, 1968: 53-55 (larva, pupa, descr., figs.). Morales et al., 1969a: 378 (Colombian record). Henriquez et al., 1970: 768 (Venezuelan record).

*Lutzomyia cayennensis*: Barretto, 1962: 95 (as type species of *Micropygomyia*). Martins et al., 1962a: 389 (cf. to *acanthopharynx*). Theodor, 1965: 186 (♂, ♀, figs.). Lewis, 1967a: 76 et seq. (classif., ♀ keyed, refs.). Aitken et al., 1968: 264 (Trinidad). Williams, 1970: 332 et seq. (summary of collecting data, Belize). Christensen et al., 1971: 118 (mention). Christensen, 1972a: 88 (listed). Christensen et al., 1972: 57 (collecting data, Panama). Osorno et al., 1972a: 38 (Colombian records). Forattini, 1973: 122 et seq. (gen. review, figs.). Christensen & Herrero, 1973: 579 (Panamanian record). Lewis, 1975a: 502 et seq. (mouthpart morphol., figs.).

*Distribution*: Mexico, Central America, Colombia (Antioquia, Bolivar, Caldas, Cesar, Cundinamarca, Guajira, Huila, Magdalena, Norte de Santander, Santander, Tolima), Ecuador, Venezuela, Trinidad, West Indies, French Guiana.

*Material examined*: Colombia. 2 ♂♂, Cauca (Antioquia), light trap, 15 Feb. 1972, J. Longridge. 1 ♂, 2 ♀♀, ca. 10 km SE of Santa Marta



(Magdalena), tree trunks, 17 Aug. 1973, D.G.Y. & R.C.W. *Costa Rica*.  
4 ♂♂, Barranca (Puntarenas), tree buttresses, 17 Dec. 1951, R. Rosabal.  
*Panama*. 19 ♂♂, 30 ♀♀, various localities in the Canal Zone & Panama  
Prov. *Trinidad*. 7 ♂♂, 2 ♀♀, Bush Bush Forest, Nariva Swamp, 1961-1962,  
T.H.G. Aitken. *Venezuela*. 1 ♂, 1 ♀, Mene Mauroa (Falcon), in house,  
I.Ortiz. 1 ♀, near Calabozo (Guarico), outside wall of house, July  
1965, D.G.Y.

*Discussion:* The *cayennensis* specimens from near Santa Marta agree with the descriptions of Floch and Abonnenc (1941a, 1952) and thus, I believe, represent *L. cayennensis cayennensis*, the nominate subspecies.

The other *cayennensis* subspecies, now 6 in number, were discussed and keyed by Lewis (1967a). The status of some of these, as noted by him, can be established only when additional material become available.

It may be noteworthy here to report the presence of *L. cayennensis* in Cuba. The single female, captured in a light trap at Guantanamo Bay, U.S. Naval base, Jan. 1970, J.E. Tisdale, is slightly damaged but it resembles *L. c. jamaicensis* (Fairchild & Trapido) in details of the cibarial armature and spermathecae.

The *cayennensis* female is easily distinguished from other *Lutzomyia* females in Colombia by the comb-like row of horizontal teeth and armed pharynx.

96. *Lutzomyia micropyga*  
(Fig. 80)

*Phlebotomus micropygus* Mangabeira, 1942a: 132 (♂, Aura, Belem, Para State, Brazil). Damasceno et al., 1949: 829 (Para, Brazil record). Barretto, 1950a: 107 (♂ keyed). Floch & Abonnenc, 1952: 37 (♂ keyed).

Scorza & Ortiz, 1960: 434 et seq. (ecologic study). Pifano et al., 1962: 385 (♂ keyed), 402-403 (♂, ♀, descr., figs.). Scorza et al., 1963: 441 (mention). Ortiz & Scorza, 1963: 342 (collecting data, Venezuela). Ortiz, 1965a: 209 (♀ keyed). Scorza et al., 1967: 190 et seq. (distrib., ♂, ♀, keyed, collecting data). Lucena, 1967: 274-276 (♂ redescri., figs., Peru). Leon, 1968: 30 (listed). Morales et al., 1968a: 380-381 (Colombian records).

*Lutzomyia micropyga*: Barretto, 1962: 96 (listed). Martins et al., 1963: 334 (Roraima, Brazil). Martins et al., 1965: 3 (Rondonia, Brazil). Aitken et al., 1968: 264 (Trinidad). Thatcher, 1968b: 1142-1143 (arboreal breeding sites, Panama). Tesh et al., 1971a: 153 (blood meals). Chaniotis et al., 1971a: 344 et seq. (pop. dynamics, Panama). Christensen et al., 1972: 57 (collecting data). Chaniotis et al., 1972: 95 (resting sites, Panama). Christensen, 1972a: 88 (listed). Llanos, 1973: 34 (♂, ♀, redescri., ♂ figs.). Christensen & Herrer, 1973: 579 (collecting data). Forattini, 1973: 139 et seq. (in part, figs., most information pertains to *L. schreiberei*, distrib.). Martins et al., 1975: 766 et seq. (refs., cf. to *schreiberei*, distrib.). Llanos, 1975b: 670 (Peru). Herrer & Christensen, 1976b: 62 (collecting data). Llanos et al., 1976: 480 et seq. (♀, descr., figs., refs., Peru). Martins et al., 1976b: 496 (Peru). Lainson et al., 1977 (Mato Grosso, Brazil).

*Distribution*: Panama, Colombia (Bolívar, Boyacá, Caldas, Chocó, Cundinamarca, Guajira, Magdalena, Meta, Norte de Santander, Santander, Tolima), Ecuador, Peru, Brazil, Venezuela, Trinidad.

*Material examined*: Colombia. 1 ♂, 1 ♀, Curiche (Chocó), tree trunk, 5 May 1967, D.G.Y. 1 ♀, Teresita (Chocó), tree trunk, 23 June 1967, D.G.Y. 1 ♂, Rio Don Diego E of Santa Marta (Magdalena), tree trunk, 15

Aug. 1973, D.G.Y. & R.C.W. 7 ♂♂, 6 ♀♀, same data but ca. 10 km SE of Santa Marta, 17 Aug. 1973. *Brazil*. 3 ♂♂, 5 ♀♀, Labrea (Amazonas), tree trunks, 10 Oct. 1972, D.G.Y. 1 ♂, Rio Aripuana at Humboldt (Mato Grosso), tree trunk, 17 Aug. 1974, D.G.Y. *Ecuador*. 1 ♂, Rio Napo at Limoncocha (Napo), tree trunk, 23 May 1976, D.G.Y. & T. Rogers. *Panama*. 12 ♂♂, 2 ♀♀, localities in Panama and Colon Provinces & Canal Zone. *Trinidad*. 3 ♂♂, 4 ♀♀, Bush Bush Forest, Nariva Swamp 1962-1964, T.H.G. Aitken. *Venezuela*. 2 ♀♀, Agua Santa (Trujillo), tree trunk, 10 Sept. 1965, D.G.Y.

*Discussion:* Several references to "*L. micropyga*" including those by Sherlock & Carneiro (1962, 1964), Carneiro & Sherlock (1964), and Sherlock & Pessoa (1966) refer not to that species but, instead, to *L. schreiberi* -- a closely related taxon from Brazil (Martins et al., 1975). The males of both species have remarkably small genitalia but are distinguished by the position of the apical spines on the style (1 terminal spine in *schreiberi*, 2 terminal spines in *micropyga*); by the pigmentation of the pleura (pale in *schreiberi*, dark in *micropyga*) and by the fact that the profemora of both sexes of *micropyga*, unlike those of *schreiberi*, are shorter than the protibiae. This latter feature appears to be unique among the *Lutzomyia* species as pointed out by Martins et al. (1975) and Llanos et al. (1976).

Both *L. minasensis* (Mang.) from Brazil and *L. quadrispinosa* (Floch & Chassignet) from French Guiana are treated as junior synonyms of *L. micropyga* by Forattini (1973).

Unlike the *micropyga* male, however, that of *minasensis* has pale pleura, the genitalia are larger, the style has but 1 terminal spine, and the profemur is longer than the protibia. I examined 3 ♂♂ of *minasensis* from Minas Gerais, Brazil, which were identified by Prof. A.V.

Martins and which agree with Mangabeira's original description of the species.

According to Martins et al. (1970), the *minasensis* female is nearly indistinguishable from that of *L. oliveirai* Martins, da Silva & Falcão, (1970). The individual sperm ducts markedly widen towards the junction with the common duct unlike those of *micropyga* which are subequal in width throughout (Fig. 80G). The pharynx of the *micropyga* female is armed with short spines (Fig. 80E) unlike *minasensis* in which they are lacking.

I should point out that Forattini's concept (1973) of *L. micropyga* was based partly upon the studies of Sherlock & Carnherio (1964, 1966) but, as noted above, they were dealing with *L. schreiberi*, not *L. micropyga* (Mang.). It is thus understandable why Forattini (op. cit.) considered it and *minasensis* to be conspecific, the males of each having 1 terminal spine on the style and with pale pleura. The larger size of the *minasensis* genitalia and differences in the females (similar to those between *micropyga* and *minasensis*) indicate, however, that *schreiberi* is distinct from *minasensis*.

Based solely on the descriptions of *L. quadrispinosa* by Floch & Chassignet (1947b) and Floch & Abonnenc (1952), I am not convinced that it and *micropyga* are conspecific. Only the male of the former taxon is known. It has very small genitalia, like *micropyga*, but the parameres are more slender apically. I have not observed such slender parameres in any of the *micropyga* males examined. The length of the profemur and protibia was not mentioned in the descriptions of *quadrispinosa*. It seems, then, that additional material of this taxon is needed from French Guiana to firmly establish its status.

The female of *micropyga* was described by Pifano et al. (1962) and Llanos et al. (1976), the latter authors noting that the cibarium generally has 4 or 5 horizontal teeth but illustrating a specimen which has 7. All of the females examined by me from Colombia and elsewhere have 4 distinct teeth (Fig. 80J). They agree with the descriptions cited above in all other character states.

Flagellates of uncertain identity were recovered from a *micropyga* female in Panama (Christensen et al., 1972). These parasites were found posterior to the midgut, similar in position to those observed in *L. schreiberei* females by Sherlock & Pessoa (1966, as *micropyga*). According to Tesh et al. (1971a), *L. micropyga* in Panama feeds principally on cold-blooded vertebrates.

Series *atroclavata*

97. *Lutzomyia atroclavata*  
(Fig. 81)

*Phlebotomus atroclavatus* Knab, 1913: 135 (♂, ♀, Gasparee Island, Trinidad). Barretto, 1947: 186-187 (full refs., synonyms). Dampf, 1947: 296-305 (refs., ♂ redescri., full refs., figs.). Fairchild & Hertig, 1948b: 455 et seq. (♂, ♀, redescri., figs., refs., synonyms). Fairchild & Trapido, 1950: 405, 409 (♂, ♀, keyed). Barretto, 1951: 212 (distr.). Floch & Abonnenc, 1952: 34, 47 (♂, ♀, keyed), 107-112 (♂, ♀, redescri., figs.). Scorza & Ortiz, 1960: 434 et seq. (biology). Pifano et al., 1962: 387, 389 (♂, ♀, keyed), 398-400 (♂, ♀, redescri., figs., synonyms, refs.). Fauran et al., 1966: 904-908 (♂, redescri., figs. Martinique). Osorno et al., 1967: 28 (Colombian record). Henriquez et al., 1970: 768 (Venezuelan record).

*Phlebotomus tejerae* Larrousse, 1922: 71, 73 (♂, ♀, Zulia State, Venezuela). Dyar, 1929: 120 (as synonym of *atroclavatus*). Barretto, 1947: 187 (refs.).

*Phlebotomus guadeloupensis* Floch & Abonnenc, 1945a: 1 (♂, ♀, Guadeloupe). Dampf, 1947: 302 (as synonym of *atroclavatus*). Fairchild & Hertig, 1948b: 456-460 (as synonym of *atroclavatus*). Courmes et al., 1966: 217 et seq. (as possible vector of kala-azar in Guadeloupe).

*Intomyia atroclavata*: Theodor, 1965: 195 (♀, figs.). Forattini, 1971a: 101 (listed). Christensen, 1972a: 88 (listed). Osorno et al., 1972a: 63-65 (Colombian records). Forattini, 1973: 211 et seq. (in part, gen. review, figs.).

*Distribution*: Panama, Colombia (Boyaca, Caldas, Cundinamarca, ?Guajira, Huila, Magdalena, ?Meta, Norte de Santander, Santander, Tolima), Venezuela, Trinidad, and other islands in the West Indies.

*Material examined*: Colombia. 2 ♀♀, SE of Santa Marta near Minca (Magdalena), tree trunk, 17 Aug. 1973, D.G.Y. & R.C.W. Panama, Trinidad, Venezuela, and West Indies (St. Croix, Virgin Islands, Granada, St. Lucia). 51 ♂♂, 19 ♀♀.

*Discussion*: Although generally having a maritime distribution (Fairchild & Hertig, 1948b), *L. atroclavata* was reported from several inland localities in Colombia by Osorno et al. (1972a). The records based upon males are undoubtedly correct but the females from Guajira and Meta Depts. may represent, instead, those of *venezuelensis* (= *zuliaensis*), the males of which were taken with the females in these two Departments. The females are very similar in structural details.

At present there is no evidence to support the suggestion by Courmes et al. (1966) that *L. atroclavata* may be the vector of kala-azar in Guadeloupe, W.I.

Specimens are usually found resting in hollow trees, on tree trunks, or in dark crevices. The feeding habits remain virtually unknown.

98. *Lutzomyia venezuelensis*  
(Fig. 82)

*Phlebotomus venezuelensis* Floch & Abonnenc, 1948b: 1 (♂ holotype, Selva de Tamanaco, Zulia State, Venezuela). Pifano & Ortiz, 1952: 145 (distrib.). Scorza & Ortiz, 1960: 434 et seq. (ecologic study). Pifano et al., 1962: 387, 389 (♂, ♀, keyed), 403-404 (♂, ♀, redescri., figs.). Ortiz & Scorza, 1963: 343 et seq. (collecting data, Venezuela). Ortiz & Alvarez, 1963a: 286 (mention). Scorza et al., 1963: 441 (mention). Leon, 1968: 31 (listed).

*Phlebotomus zuliaensis* Floch & Abonnenc, 1948b: 5 (♀, Zulia State, Venezuela). Pifano & Ortiz, 1952: 147 (distrib., ♀ keyed). Scorza & Ortiz, 1960: 434 (as probable synonym of *venezuelensis*). Pifano et al., 1962: 403 (as synonym of *venezuelensis*). Scorza et al., 1963: 441 (mention). Leon, 1968: 31 (listed).

*Lutzomyia venezuelensis*: Barretto, 1962: 96 (listed). Theodor, 1965: 185 (listed). Forattini, 1971a: 102 (listed). Osorno et al., 1972a: 36 (Colombian records). Forattini, 1973: 312 (as synonym of *oswaldoi*). Lewis, 1975a: 502 et seq. (mouthpart morphol.).

*Lutzomyia zuliaensis*: Theodor, 1965: 195 (cf. to *atroclavata*). Forattini, 1971a: 101 (as synonym of *atroclavata*). Forattini, 1973: 281 (as synonym of *atroclavata*).

*Distribution*: Colombia (Antioquia, Magdalena, Meta, Norte de Santander, Guajira), Venezuela.

*Material examined:* Colombia. 2 ♀♀, Caucasias (Antioquia), light trap, 29 April 1972, J. Longridge. 1 ♂, Minca, SE of Santa Marta (Magdalena), tree trunk, 17 Aug. 1973, D.G.Y. & R.C.W. 6 ♂♂, same data but 10 km SE of Santa Marta.

*Discussion:* *Lutzomyia zuliaensis* (Floch & Abonnenc) from Venezuela is probably the female of *L. venezuelensis* (Floch & Abonnenc) as stated by Pifano et al. (1962). This association is based upon collecting data and morphology. The pharynx of the *venezuelensis* male, although smaller and lacking spines, is generally shaped like that of *zuliaensis* and *atroclavata*.

The males of *atroclavata* and *venezuelensis* are nearly identical in most character states but differ readily by one feature -- the number and nature of the coxite setae (cf. Fig. 81F and Fig. 82). The larger horizontal teeth and smaller pigment patch in the cibarium of the *venezuelensis* (Fig. 82) female contrasts with those observed in that of *atroclavata* (Fig. 81J).

Forattini (1973) treats *L. venezuelensis* as a junior synonym of *L. oswaldoi* (Mang.) but the latter male has 5 major spines on the style and the female pharynx is unarmed.



Figure 79

*Lutzomyia cayennensis* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, G. Spermathecae of female from Trinidad, H. Female wing, I. Male wing, J. Female cibarium.

Male: Trinidad

Female: Falcon State, Venezuela (except Fig. 79G)

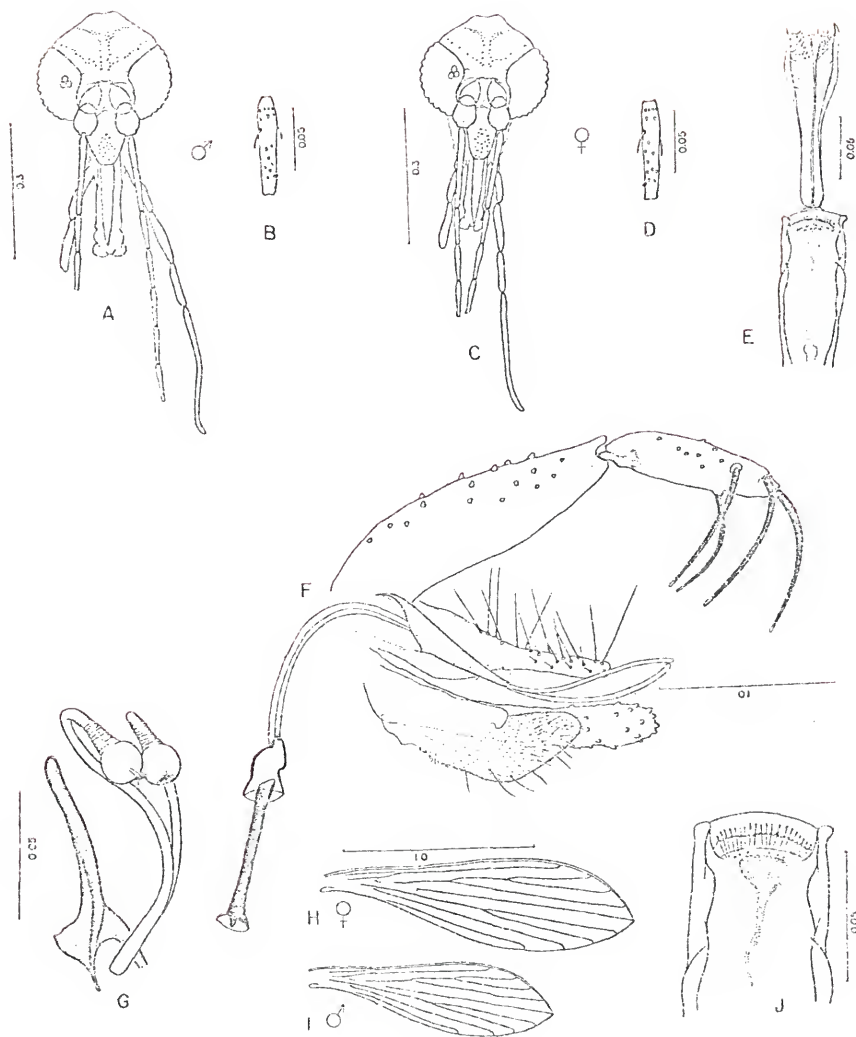


Figure 80

*Lutzomyia micropyga* -- A. Female head, B. Female flagellomere II, C. Male head, D. Male flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, G. Spermathecae, H. Female wing, I. Male wing, J. Female cibarium.

Male: Curiche, Choco Dept., Colombia

Female: Same locality as male

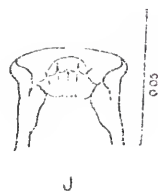
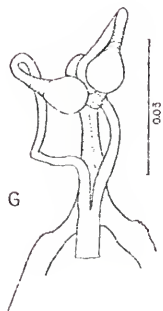
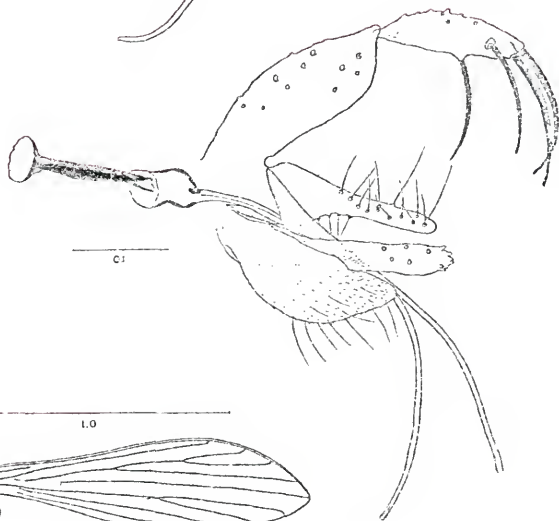
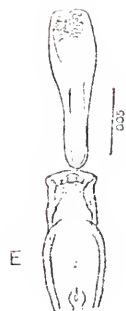
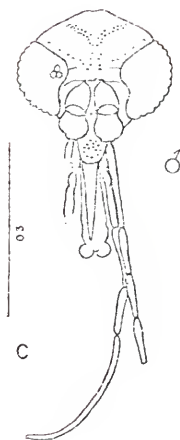
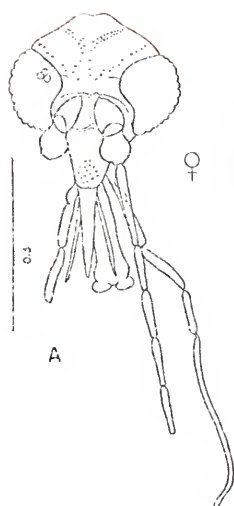


Figure 81

*Lutzomyia atroclavata* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Male genitalia, G. Spermathecae, H. Female wing, I. Male wing, J. Female cibarium.

Male: Trujillo State, Venezuela

Female: Same locality as male

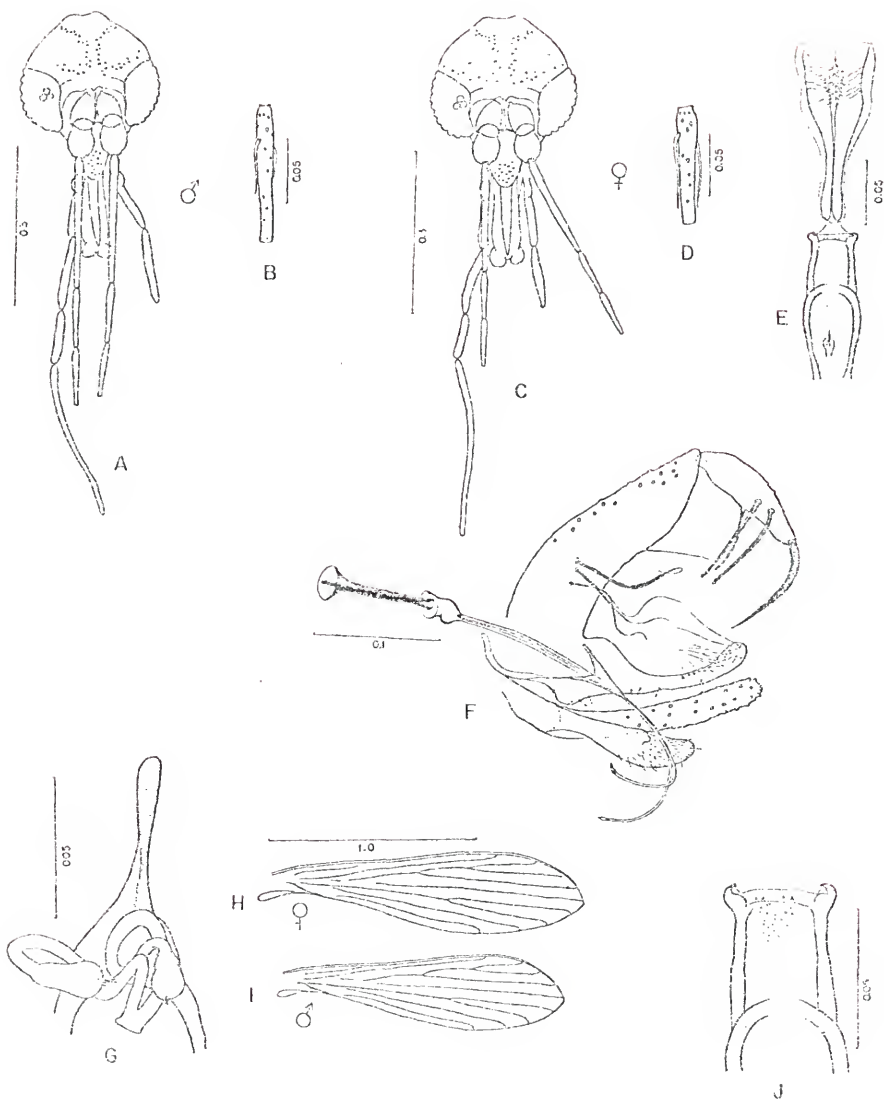
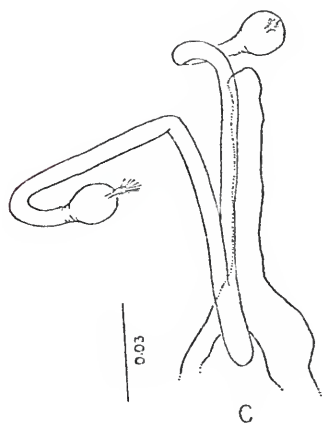
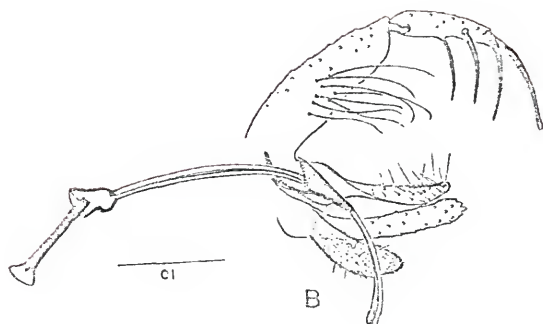
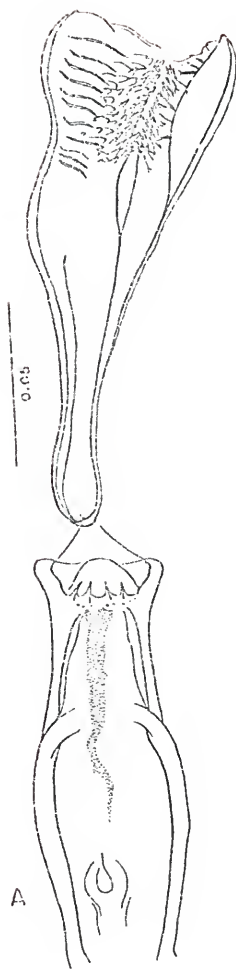


Figure 82

*Lutzomyia venezuelensis* -- A. Female cibarium and pharynx, B. Male genitalia, C. Spermathecae.

Male: Minca, Magdalena Dept., Colombia

Female: Caucasia, Antioquia Dept., Colombia





Oswaldoi Group Theodor, 1965

This group of over 16 described species was defined by Theodor (1965) and by Barretto (1962) as group 2 (*oswaldoi*) of the subgenus *Helcoerytomyia* Barretto, 1962. Three species are known from Colombia.

The majority of species occur in South America, especially Brazil, where they are found most commonly on tree trunks and sometimes in light traps. The females, except for *L. pia* which may not be closely allied with the others, can not be regarded as anthropophilic. A few species such as *L. oswaldoi* (Mang.), *L. rorotaensis*, and *L. trinidadensis* are known to feed on poikilothermic vertebrates. The latter species, placed with the ungrouped species by Theodor (1965), is treated here as a member of the *oswaldoi* group based upon the female cibarium, male genitalia, and palpi of both sexes.

The status of some taxa remains to be clarified.

Keys to Species

Males

- i. Style with 1 terminal spine and a subterminal seta. Palp 5 subequal in length to 3 + 4 . . . . . *pia* (Fig. 83)
- Style with 2 terminal spines\* but lacking a subterminal seta. Palp 5 much longer than 3 + 4 . . . . . 2

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\*As discussed under *L. rorotaensis* (p. 421), some males have only 4 spines on the style; in which case, only 1 is terminal. The subterminal seta is absent.

2. Head and body markedly infuscated, lower part of pleura with faint pigmentation. Style with 1 terminal spine much smaller than the other . . . . . *rorotaensis* (Fig. 84)

Head and body faintly infuscated, pleura entirely pale. Style with terminal spines subequal in size. . . . . *trinidadensis* (Fig. 85)

Females

1. Pharynx armed with conspicuous spines. Spermathecae cylindrical (sausage-shaped) and smooth-walled. . . . . *trinidadensis* (Fig. 85)

Pharynx unarmed. Spermathecae otherwise, with complete or incomplete annulations . . . . . 2

2. Spermathecae with terminal annulation much smaller than others.

Cibarium with 4-6 sharp, nearly straight horizontal teeth. Labrum length subequal to head height. . . . . *pia* (Fig. 83)

Spermathecae with large hemispherical head. Cibarium with 4-6 horizontal teeth, inner pair bent inwards. Labrum much shorter than head height. . . . . *rorotaensis* (Fig. 84)

99. *Lutzomyia pia*  
(Fig. 83)

*Phlebotomus pius* Fairchild & Hertig, 1961b: 248 (♂ holotype, Santa Clara, El Volcan, Chiriquí Prov., Panama; ♀, Palo Santo, Chiriquí Prov., Panama). Ortiz & Alvarez, 1963b: 313 (mention). McConnell & Correa, 1964: 528 (parasitized with mites).

*Lutzomyia pia*: Theodor, 1965: 187 (listed). Forattini, 1971a: 102 (listed). Osorno et al., 1972a: 45 (Boyaca, Colombia). Forattini, 1973: 189 et seq. (gen. review, figs.).

*Distribution*: Costa Rica, Panama, Colombia (Boyaca).

*Material examined*: Colombia. 1 ♂, 1 ♀ (nos. 1925 and 1929, INPES), Vereda Umbabita, Municip. Almeida (Boyaca), tree hollow, 4 July 1968, E. Osorno, A. Morales, & J. Ochoa. Costa Rica. 1 ♀, Moravia (Chirripo), Shannon trap, 4 March 1966, R. Zeledon. Panama. 1 ♂ (holotype no. 2428), type locality, tree buttress, 11 Aug. 1950, R. Hartmann. 1 ♀ (allotype no. 2269), Palo Santo (Chiriqui), tree buttress, 19 May 1950, R. Hartmann. 18 ♀♀, Rio Changena (Bocas del Toro), biting man, 8 Sept. 1961, V. Tipton. 3 ♂♂, 97 ♀♀, same data but Shannon trap, 12 Sept. 1961.

*Discussion*: Both sexes of *L. pia* differ from other *oswaldoi* group species in several features, the most notable being: 1) The presence of a subterminal seta on the male style. 2) The female cibarium with 4-6 sharp, nearly straight horizontal teeth and a prominent, complete cibarial arch. 3) The man-biting habit of the females. 4) The unusual spermathecae and 5) The relatively short palp 5 of both sexes. The species is placed here chiefly on the basis of the male genitalia.

In the original description (Fairchild and Hertig, 1961b), the authors stated that there are 6 horizontal teeth in the female cibarium. One of the paratypes figured by them shows this number but the majority of females, including the allotype and a Colombian specimen, have only 4 such teeth. Of 103 females examined for this feature, 100 had 4 teeth, the remainder had 5.

The Colombian specimens agree closely with the holotype and allotype of *L. pia* and are undoubtedly conspecific. The present, apparently

disjunct distribution of this species suggests that populations were continuous in times past from northern Colombia to Costa Rica.

100. *Lutzomyia rorotaensis*  
(Fig. 84)

*Phlebotomus rorotaensis* Floch & Abonnenc, 1944d: 4 (♂ holotype, ♀, Rorota, French Guiana). Barretto, 1946c: 431 (♂ keyed). Barretto, 1947: 216 (as synonym of *oswaldoi*, in part); 221 (refs.). Floch & Abonnenc, 1950b: 9 (cf. to related spp., refs.). Barretto, 1950b: 145 (cf. to *zikari*). Barretto, 1951: 223 (distrib.). Vargas & Diaz-Nájera, 1952: 72-73 (cf. to *durani*). Floch & Abonnenc, 1952: 41, 45 (♂, ♀, keyed), 167-170 (♂, ♀, redescr., figs.).

*Lutzomyia rorotaensis*: Martins et al., 1961a: 300 (mention). Barretto, 1961: 1 (as synonym of *vilhelai* Mang.). Martins et al., 1963: 335 (as a distinct species, Roraima, Brazil). Lewis et al., 1970: 215 (parous rates). Forattini, 1971a: 102 (as a synonym of *trinidadensis*). Tesh et al., 1971a: 152 et seq. (reptile and/or amphibian blood meals). Chaniotis et al., 1971a: 344 (pop. dynamics, Panama). Chaniotis et al., 1972: 93 et seq. (tree trunks as resting sites). Christensen, 1972a: 88 (listed). Osorno et al., 1972a: 45 (Colombian records). Forattini, 1973: 312 (as synonym of *oswaldoi*). Rutledge & Ellenwood, 1975a: 71 et seq. (breeding on open forest floor); 1975b: 82; 1975c: 83 et seq. Lewis, 1975a: 502 et seq. (mouthpart morphol.).

*Distribution*: Panama, Colombia (Antioquia, Choco, Valle), French Guiana.

*Material examined*: Colombia. 1 ♂, 2 ♀♀, Rio Anori (Antioquia), tree buttresses, Sept. 1970, D.G.Y. 1 ♀, Alto Curiche (Choco), tree buttress,

4 April 1967, D.G.Y. 1 ♂, 3 ♀♀, Anchicaya Dam (Valle), tree trunks, 9 Aug. 1973, D.G.Y. & R.C.W. 14 ♂♂, 8 ♀♀, 20 km E of Buenaventura (Valle), tree trunks, 11 Aug. 1973, D.G.Y. & R.C.W. *Brazil*. 4 ♂♂, 2 ♀♀, Serra do Navio (Amapa), tree trunks, 21 Sept. 1972, D.G.Y. & H. Fraiha. *Panama*. 13 ♂♂, 8 ♀♀, various localities in Panama & Colon Provinces & Canal Zone.

*Discussion:* *Lutzomyia rorotaensis* males from Valle Dept., Colombia, are unique among the *oswaldoi* group species in having 4 instead of 5 spines on each style. This reflects intraspecific variation in my opinion, because other features of both sexes from there and elsewhere are nearly identical.

Where they occur together in northern Colombia, Panama, and French Guiana, this species and *L. trinidadensis* are found often on tree trunks, the latter species almost always more abundant. Females of both species feed on cold blooded vertebrates (Tesh et al., 1971a). The immatures are known to live on the open forest floor (Rutledge and Ellenwood, 1975a).

*Lutzomyia oswaldoi* (Mang.) a Brazilian species is treated as a senior synonym of *L. rorotaensis* and *L. venezuelensis* (Floch and Abonnenc) by Forattini (1973). The latter taxon, obviously distinct from the others, is actually conspecific with *L. zuliaensis* (see p. 408).

The differences between *oswaldoi* and *rorotaensis* are not as salient, however, and without material of *oswaldoi*, I am unable to judge whether or not they are conspecific. For the present, I prefer to separate them, pointing out that Panamanian and Colombian specimens (except those from Valle Dept., Colombia) agree closely with a male (no. 2295) and female (no. 2277) from Panama which were compared with the types from French Guiana by Dr. H. Floch in 1952 (Dr. G.B. Fairchild, pers. comm.).

101. *Lutzomyia trinidadensis*  
(Fig. 85)

*Phlebotomus trinidadensis* Newstead, 1922: 4 (♂, ♀, Trinidad). Fairchild & Hertig, 1948a: 253 et seq. (full refs., synonyms, ♂, ♀, redescri., figs.). Hertig & Fairchild, 1950: 91 et seq. (sternites, figs.). Barretto, 1951: 224 (distrib.). Rosabal, 1954: 25 et seq. (♂, ♀, measurements, Costa Rica, figs.). Deane & Deane, 1957: 225 et seq. (Ceara, Brazil). Fairchild & Hertig, 1959: 122-124 (Central American records). Lewis & Garnham, 1959: 83 (Belize, figs.). Hanson, 1961: 320 (larvae in soil between tree buttresses, Panama). Johnson & Hertig, 1961: 765 et seq. (rearing data). Pifano et al., 1962: 384, 388 (♂, ♀, keyed), 407 et seq. (♂, ♀, redescri., refs., figs.). McConnell & Correa, 1964: 523 et seq. (infected in nature with trypanosomes, gregarines, and fungi). Thatcher & Hertig, 1966: 46 et seq. (host preferences, Panama). Osorno et al., 1967: 29 (Colombian records). Hanson, 1968: 84 et seq. (larva, pupa, descr., figs.). Thatcher, 1968a: 296 (in castor oil traps).

*Phlebotomus yucatanensis* Galliard, 1934: 1 (♂, ♀, near Chichenitza, Yucatan, Mexico). Barretto, 1947: 232 (full refs.). Fairchild & Hertig, 1948a: 255 (as synonym of *trinidadensis*). Mirsa, 1953: 63 et seq. (rearing data).

*Phlebotomus yucatanensis* var. *baduelensis* Floch & Abonnenc, 1941b: 4 (♂, Baduel, French Guiana). Fairchild & Hertig, 1948a: 225 (as synonym of *trinidadensis*).

*Phlebotomus longipalpis*: Ristorcelli & Van Ty, 1941: 252 et seq. (♀, Narino, Colombia, figs.). Not *longipalpis* Lutz & Neiva, 1912, as noted by Fairchild & Hertig (1948a).

*Phlebotomus vilhelmai* Mangabeira, 1942a: 196 (♂, Ceara & Para States, Brazil). Barretto, 1946b: 527 (as synonym of *baduelensis*, refs.). Fairchild & Hertig, 1948a: 255 (as synonym of *trinidadensis*).

*Phlebotomus baduelensis* Floch & Abonnenc, 1944d: 1 (♂, ♀, French Guiana). Fairchild & Hertig, 1948a: 255 (as synonym of *trinidadensis*). Floch & Abonnenc, 1952: 41, 44 (♂, ♀, keyed), 163-167 (♂, ♀, redescr., figs.).

*Lutzomyia trinidadensis*: Martins et al., 1961a: 300 (mention). Martins et al., 1962a: 385 (cf. to *goiana*). Martins et al., 1965: 4 (Rondonia, Brazil). Aitken et al., 1968: 264 (Trinidad). Williams, 1970: 332 et seq. (summary of collecting data, Belize). Tesh et al., 1971a: 153 (amphibian and/or reptilian blood meals). Chaniotis et al., 1971a: 344 (pop. dynamics, Panama). Chaniotis, 1971: 459 (♀ gyandromorphs, figs.). Chaniotis et al., 1971b: 417 (mention). Osorno et al., 1972a: 67-75 (Colombian records). Chaniotis et al., 1972: 95 (resting sites). Christensen 1972a: 88 (listed). Christensen, 1972b: 683-686 (rearing. Christensen et al., 1972: 57 et seq. (collecting data, infected with nonleishmanial flagellates, Panama). Velasco, 1973: 92 (Bolivian records). Forattini, 1973: 90 et seq. (gen. review, figs.). Christensen & Herrer, 1973: 579 (collecting data). Chaniotis & Correa, 1974: 115 (collecting data). Llanos et al., 1975b: 671 (Peru). Lewis, 1975a: 502 et seq. (mouthpart morphol., figs.). Rutledge & Ellenwood, 1975a: 73 et seq. (open forest floor breeding sites); 1975c: 87 (same). Rutledge & Mosser, 1975: 411 (mention). Martins et al., 1976b: 496 (Peru). Llanos et al., 1976: 480 (Peru). Herrer & Christensen, 1976b: 62 (collecting data, Panama). Williams, 1976a: 601 (in caves Belize); 1976b: 615 et seq. (infected with flagellates and filarial worms).

*Lutzomyia villegasi*: Barretto, 1962: 96 (listed). Martins et al., 1962a: 393 (listed). Martins & Morales, 1972: 367 (listed).

*Brumptomyia trinidadensis*: Lewis, 1965: 376 et seq. (internal structures, figs.).

*Lutzomyia baduelensis*: Christensen et al., 1971: 118 (mention).

*Distribution*: Mexico to Brazil, Colombia (Antioquia, Bolivar, Boyaca, Caldas, Cesar, Choco, Cundinamarca, Guajira, Huila, Magdalena, Narino, Norte de Santander, Santander, Tolima).

*Material examined*: Colombia. 12 ♂♂, 3 ♀♀, Rio Anori (Antioquia), light traps & tree trunks, May 1970, C.H.P. 74 ♂♂, 52 ♀♀, same data but Sept. 1970, D.G.Y. 113 ♂♂, 74 ♀♀, Curiche (Choco), Malaise, Shannon & light traps, April-Dec. 1967, D.G.Y. 333 ♂♂, 301 ♀♀, same data but tree trunks only. 12 ♂♂, 1 ♀, Alto Curiche (Choco), tree trunks, April, May, July, Sept. 1967, D.G.Y. 451 ♂♂, 206 ♀♀, Teresita (Choco), Malaise, Shannon & light traps, tree trunks, March-Dec. 1967, D.G.Y. 3 ♂♂, 3 ♀♀, Rio Atrato at Sautata (Choco), Oct. 1967, D.G.Y. 3 ♀♀, Baraya (Huila), March 1945, M. Hertig. 35 ♂♂, 33 ♀♀, Rio Don Diego, E of Santa Marta (Magdalena), tree trunks, 15 Aug. 1973, D.G.Y. & R.C.W. 6 ♂♂, 2 ♀♀, Minca, SE of Santa Marta (Magdalena), tree trunks, 17 Aug. 1973, D.G.Y. & R.C.W. 43 ♂♂, 36 ♀♀, 10 km SE of Santa Marta (Magdalena), tree trunks, 1973. *Bolivia*. 1 ♀, Teoponte, 400 m above sea level (Larecaja), tree hole, 12 July 1971, J. Velasco. *Costa Rica, French Guiana, Nicaragua, Panama, Trinidad, & Venezuela*. 300+ ♂♂, 300+ ♀♀, various localities, dates and collectors, stored mostly in alcohol.

*Discussion*: Because of its abundance in lowland forests, *L. trinidadensis* is a familiar sand fly to specialists working in Central America and northern South America. In Choco Dept., Colombia, it was the dominant



species on tree trunks, accounting for over 50% of all phlebotomine specimens captured. Hanson (1961) recovered a few larvae from soil between tree buttresses. Rutledge and Ellenwood (1975a) secured adults in soil emergence traps on the open forest floor. In neither study were the immatures plentiful.

The females feed principally on lizards, especially geckoes, but are also known to feed on or be attracted to mammals (including man) and possibly birds (McConnell and Correa, 1964; Aitken et al., 1968; Williams, 1970, and Rutledge & Mosser, 1975).

This species and *L. cruciata* (Coq.) were confused for many years but Fairchild and Hertig (1948a) distinguished the two and provided references to the misidentifications of others.

The distribution of *trinidadensis* in Colombia is rather interesting. It is very common in northern Choco but appears to be absent, or at least very rare, in forests along the Pacific coast in Valle Dept. Neither Barreto (1969) nor ourselves noted its presence there.

I have not seen specimens referable to *trinidadensis* from the Amazon basin in Colombia or elsewhere. The status of *L. villela*, considered by most to be a junior synonym of *trinidadensis*, is not settled at present. This is also true for *L. goiana* Martins, Falcão, and da Silva, a species treated as a junior synonym of *trinidadensis* by Forattini (1973). The females differ in the size and distribution of the pharyngeal spines, those of *goiana* being reduced in size and number (Martins et al., 1962a). According to the describers, the males of *goiana* and *trinidadensis* are indistinguishable. Lewis (1975a) illustrated the ♀ cibaria of both species.

Figure 83

*Lutzomyia pia* -- A. Male genitalia, B. Female cibarium, C. Spermathecae  
of female from Palo Santo, Chiriqui Prov., Panama.

Male: Boyaca Dept., Colombia

Female: Same locality as male (except Fig. 83C)

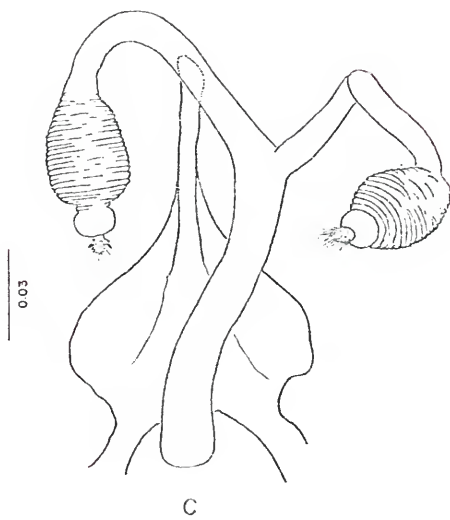
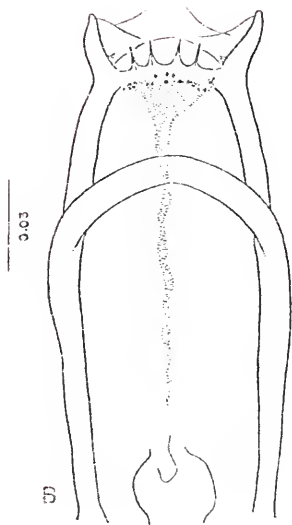
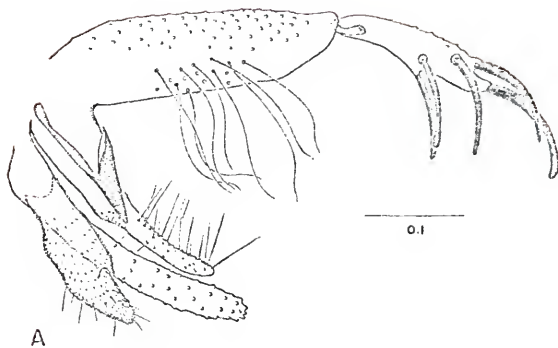


Figure 84

*Lutzomyia rorotaensis* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Genital pump and filaments, G. Genital pump, H. Male genitalia, I. Spermathecae, J. Female wing, K. Male wing, L. Female wing.

Male: Colon Prov., Panama

Female: Rio Anorí, Antioquia Dept., Colombia

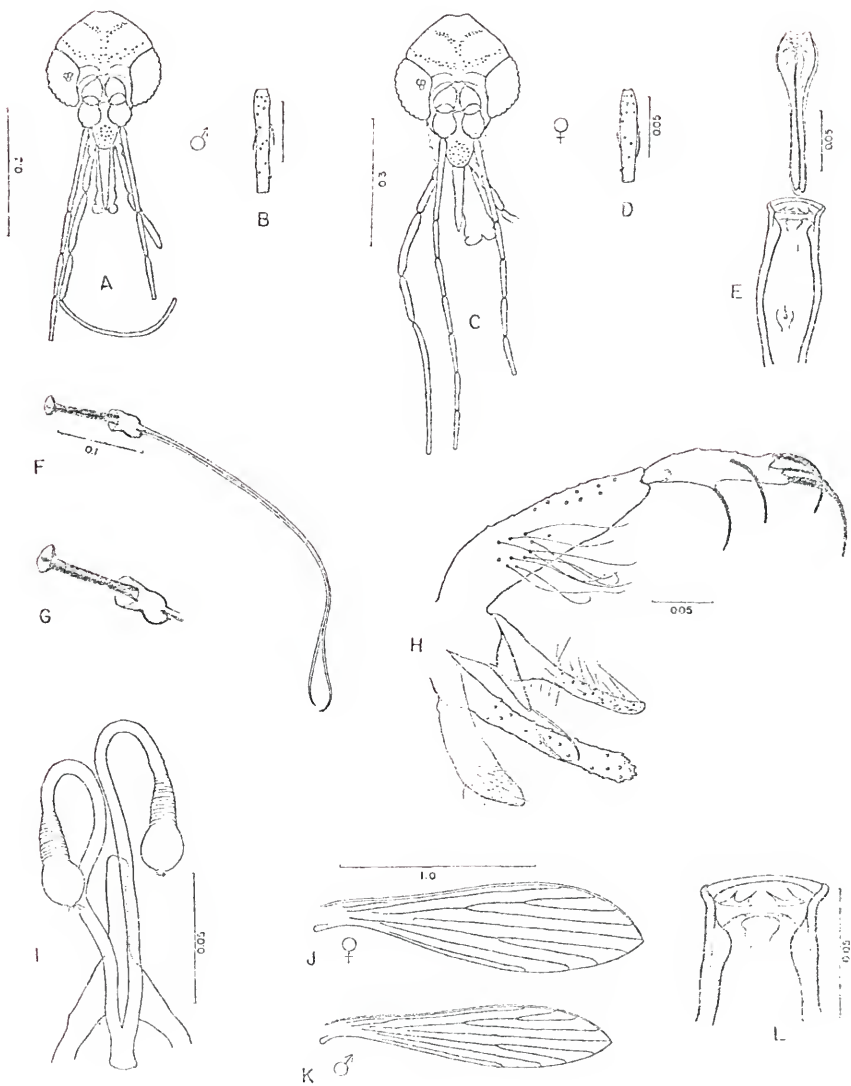
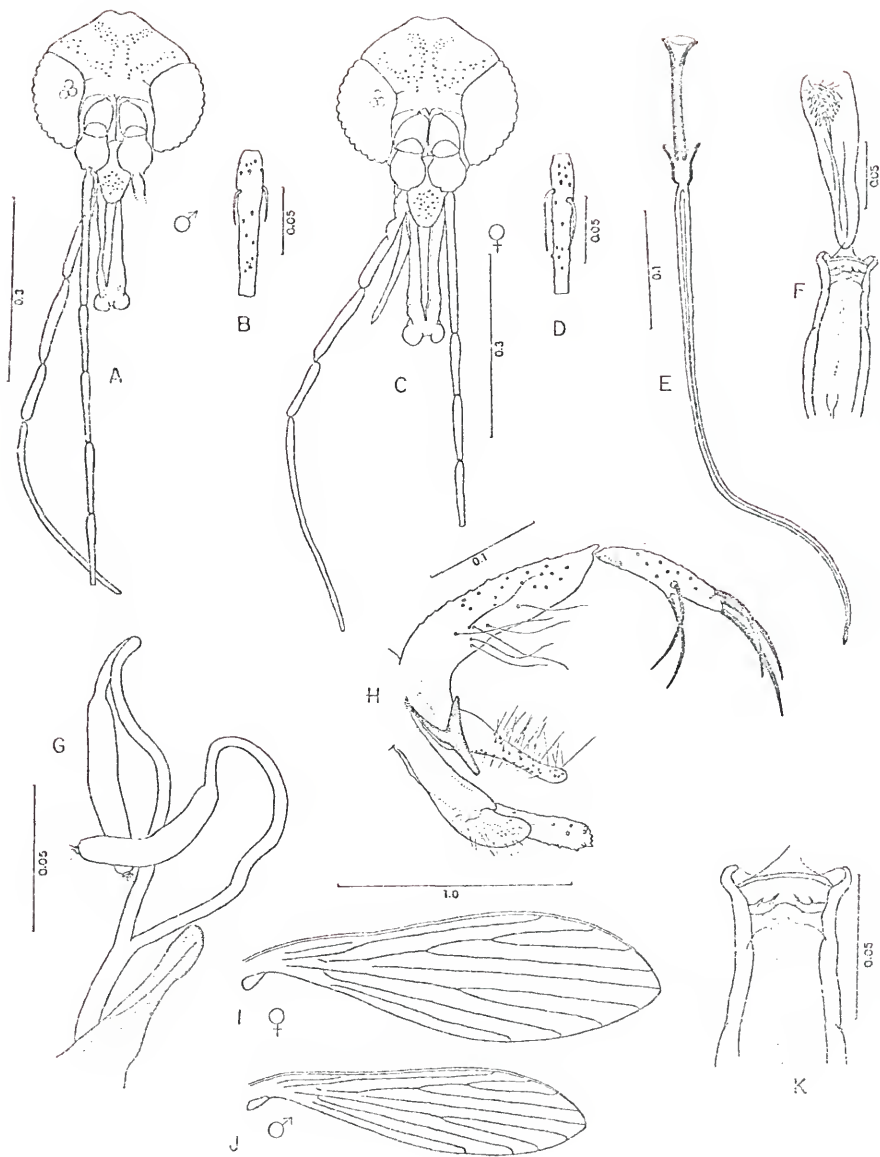


Figure 85

*Lutzomyia trinidadensis* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Genital pump and filaments, F. Female cibarium and pharynx, G. Spermathecae, H. Male genitalia, I. Female wing, J. Male wing.

Male: Curiche, Choco Dept., Colombia

Female: Same locality as male



Pilosa Group Theodor, 1965

Characterized by Theodor (1965), this group of 3 species appears to be distinct although the females resemble those in the *cayennensis* group in some aspects, notably the cibarial armature. Forattini (1971a, 1973) includes species in both groups in the subgenus *Micropygomyia* Barretto, 1962, a category established for *L. cayennensis* and its allies which is equivalent to the *cayennensis* group of Theodor (op. cit.).

At present, *L. pilosa* is the sole representative of the *pilosa* group in Colombia. *Lutzomyia chassigneti* (Floch and Abonnenc, 1944) occurs in French Guiana and Brazil and *L. mangabeirana* (Martins, Falcão and da Silva, 1963) is presently known from northern Brazil.

102. *Lutzomyia pilosa*  
(Fig. 86)

*Phlebotomus pilosus* Damasceno & Causey, 1944: 342 (♂ holotype, Santa Isabel, Belem, Para, Brazil). Barretto, 1947: 219 (ref.). Damasceno et al., 1949: 830 (Brazilian records). Damasceno & Arouck, 1949: 845 (cf. to *serrana*). Fairchild & Trapido, 1950: 410 (mention). Barretto, 1950a: 102 (♂ keyed). Barretto, 1951: 222 (distrib.). Ortiz, 1952: 155 (cf. to *rangeliana*). Floch & Abonnenc, 1952: 30 (♂ keyed). Fairchild & Hertig, 1959: 122 (Central American records). Pifano et al., 1962: 385 (♂, in key to Venezuelan sand flies).

*Lutzomyia pilosa*: Theodor, 1965: 194 (♂, genitalia figs.). Aitken et al., 1968: 264 (Trinidad). Osorno et al., 1969: 380 (Colombian record). Forattini, 1971a: 101 (listed). Osorno et al., 1972a: 62-63 (Colombian records). Christensen, 1972a: 88 (listed). Forattini, 1973: 209 et seq. (gen. review, ♂, figs.).



*Distribution:* Costa Rica, Panama, Colombia (Antioquia, Bolivar, Boyaca, Caqueta, Choco, Huila), Brazil, Venezuela, Trinidad.

*Material examined:* Colombia. 1 ♂, 1 ♀, Rio Anori (Antioquia), light trap, 3 May 1970, C.H.P. 2 ♂♂, 3 ♀♀, same locality, three buttresses, Sept. 1970, D.G.Y. 1 ♀, Puerto Boyaca (Boyaca), light trap, 6 May 1973, C.J.M. 11 ♂♂, 14 ♀♀, Alto Curiche (Choco), light & Shannon traps, tree trunks, 31 May-2 Aug. 1967, D.G.Y. Costa Rica. 1 ♀, Wauchope (Limon), tree buttress, 9 Aug. 1951, P. Galindo & H. Trapido. Panama. 3 ♀♀, Almirante (Bocas del Toro), light traps, Nov. 1952-Jan. 1953, W. Hils. coll. 1 ♂, Rio Platanar (Panama), hollow tree with bats, 20 July 1950, R. Harmann. Trinidad. 5+ ♂♂, 1 ♀, Nariva Swamp, Bush Bush Forest, various dates, T.H.G. Aitken.

*Discussion:* *Lutzomyia pilosa* and *L. chassigneti* are very similar, the male of the former species having a distal patch of coxite setae, lacking in *chassigneti*.

The *pilosa* female, known but undescribed, is described here based on 2 specimens from Alto Curiche (Choco) Colombia and 1 from Almirante (Bocas de Toro), Panama. As Theodor (1965) mentioned, the *pilosa* and *chassigneti* females are indistinguishable.

*Female:* Wing length 1.64-1.80; width 0.49-0.57. Head, mesonotum, abdominal tergites moderately pigmented, rest of insect dusky, pleura slightly paler than mesonotum. Head height 0.32-0.35; width 0.30-0.32. Eyes separated by 0.11 or by distance = to ca. 5.5 facet diameters. Flagellomere I (0.25-0.27 long), nearly 1.2 x length of II + III; ascoids single, those on flagellomere II reaching to or beyond end, on all flagellomeres except last. Length of palpal segments: 1 (0.03), 2 (0.09-0.11), 3 (0.14-0.16), 4 (0.10), 5 (0.34-0.37); palpal sensilla at

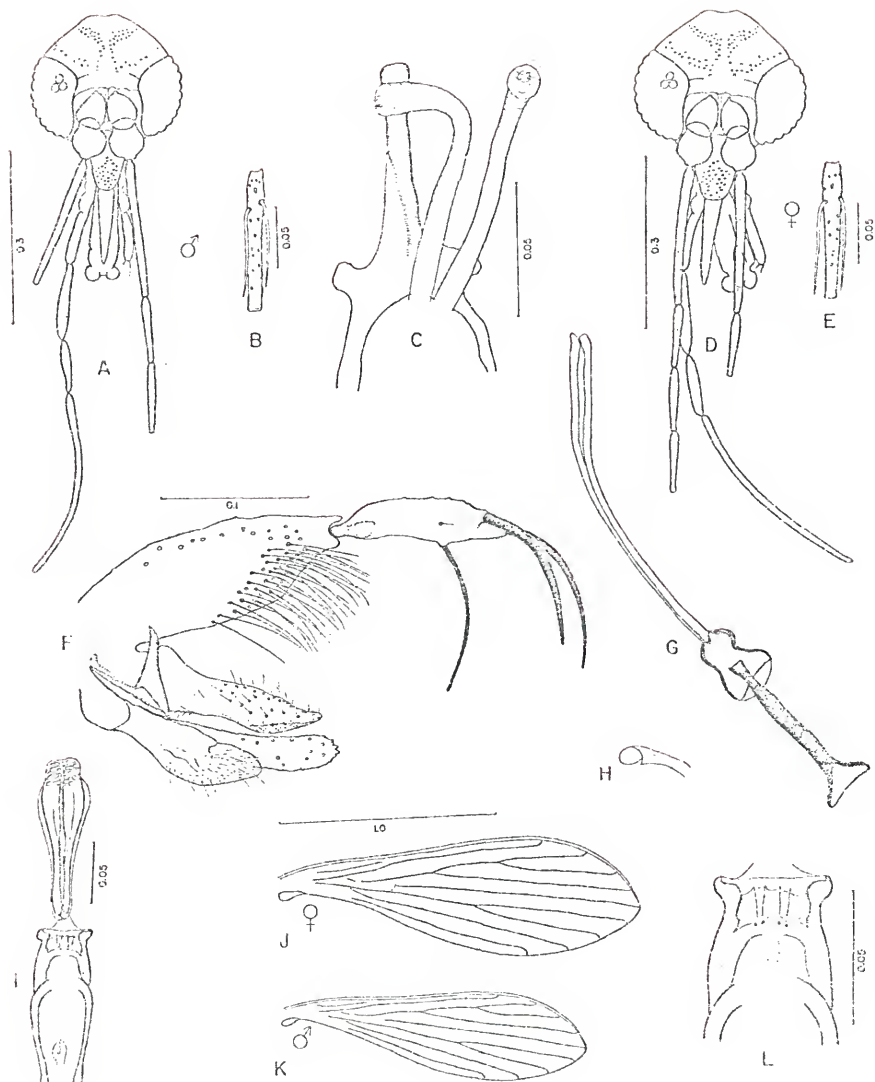
apex of segment 3. Labrum 0.15-0.16 long. Cibarium as figured. Pharynx 0.13-0.14 long, unarmed. Pleura with 5-10 upper and 3-6 lower episternal setae. Length of wing vein sections: *Alpha* (0.34-0.47), *beta* (0.29-0.31), *delta* (0.15-0.25), *gamma* (0.18-0.20). Length of femora, tibiae, and basitarsi of slide 4276 (Almirante): Foreleg, 0.71, 0.71, 0.39; midleg, 0.67, 0.83, 0.46; hindleg, 0.73, 0.98, 0.54. Abdominal sternite 2 entire, without openings, sternite 2, at least, with paired circular openings at sides. Tergite 8 with 5-10 setae on each side. Spermathecae, ducts, and cerci as shown.

Figure 86

*Lutzomyia pilosa* -- A. Male head, B. Male flagellomere II, C. Spermathecae, D. Female head, E. Female flagellomere II, F. Male genitalia, G. Genital pump and filaments, H. Tip of genital filament, I. Female cibarium and pharynx, J. Female wing, K. Male wing, L. Female cibarium.

Male: Alto Curiche, Choco Dept., Colombia

Female: Same locality as male



Ungrouped Species

103. *Lutzomyia nordestina*  
(Fig. 87)

*Phlebotomus nordestinus* Mangabeira, 1942e: 327 (♂ holotype, Nova Olinda, Ceara, Brazil). Barretto, 1947: 215 (refs.). Damasceno et al., 1949: 830 (Brazilian records). Barretto, 1951: 221 (distrib.). Floch & Abonnenc, 1952: 37, 45 (♂, ♀ keyed), 145 (♂, ♀, redescri., figs.). Rodriguez, 1956: 76 et seq. (Ecuador). Hanson, 1961: 321 (breeding site, Panama). Johnson & Hertig, 1961: 765 et seq. (rearing data. Thatcher & Hertig, 1966: 52 (in burrows, Panama).

*Phlebotomus longicornutus* Floch & Abonnenc, 1943: 6 (♂ holotype, ♀, Montabo, French Guiana). Barretto, 1946b: 534 (as synonym of *nordestina*). Forattini, 1960: 478 (Amapa, Brazil).

*Lutzomyia nordestina*: Barretto, 1962: 96 (listed). Martins et al., 1962a: 381 (Goias, Brazil). Theodor, 1965: 195 (characterized). Martins et al., 1965: 3 (Rondonia, Brazil). Martins et al., 1970: 553 (mention). Tesh et al., 1971a: 152 (blood meals). Chaniotis et al., 1971a: 344 et seq. (pop. dynamics, Panama). Christensen & Fairchild, 1971: 301 (Darién, Panama). Osorno et al., 1972a: 65-66 (Colombian records). Christensen, 1972a: 83 (listed). Christensen et al., 1972: 57 (collecting data). Chaniotis et al., 1972: 95 (resting sites). Christensen & Herrer, 1973: 579 (collecting data, Panama). Lewis, 1975a: 504 et seq. (mouthpart morphol.). Llanos et al., 1976: 480 (Peru). Martins et al., 1976b: 496 (Peru).

*Psychodopygus nordestina*: Forattini, 1971a: 105 (listed).

Forattini, 1973: 140 et seq. (gen. review, figs.).

*Distribution*: Panama, Colombia (Amazonas, Antioquia, Boyaca, Caqueta, Choco, Tolima, Valle), Ecuador, Panama, Peru, French Guiana, Trinidad, Brazil.

*Material examined*: Colombia. 1 ♀, 17 km W of Leticia (Amazonas), burrow, 26 July 1973, D.G.Y. & R.C.W. 1 ♀, Rio Anorí (Antioquia), light trap, 3 May 1970, C.H.P. 4 ♂♂, same locality, tree trunks, Sept. 1970, D.G.Y. 1 ♀, Puerto Boyaca (Boyaca), light trap, 10 Aug. 1971, C.J.M. 6 ♂♂, 16 ♀♀, Curiche (Choco), light, Malaise & Shannon traps, May-Oct. 1967, D.G.Y. 1 ♂, 7 ♀♀, Alto Curiche (Choco), light & Shannon traps, tree trunk, June-Sept. 1967, D.G.Y. 1 ♂, Anchicaya Dam (Valle), tree trunk, 9 Aug. 1973, D.G.Y. & R.C.W. 2 ♂♂, 1 ♀, 25 km E of Buenaventura (Valle), light & flight traps, 12 Aug. 1973, D.G.Y. & R.C.W. Brazil. 2 ♂♂, 5 ♀♀, 27 km SE of Marabá (Para), light traps, 26-28 Sept., 1972, D.G.Y. & H. Fraiha. 5 ♂♂, 1 ♀, same locality, burrow in leaf-cutting ant nest, 26 Sept. 1972, D.G.Y. 1 ♂, near Altamira (Para), tree trunk, 1 Oct. 1972, D.G.Y. 1 ♀, Belém (Para), flight trap, 2 Aug. 1974, D.G.Y. 1 ♀, near Bacuri, N of Marabá (Para), light trap, 28 Oct. 1974, J. Reinert. 2 ♂♂, 5 ♀♀, Rio Napo at Limoncocha (Napo), light & Flight traps, 19-24 May 1976, D.G.Y. & T. Rogers. 2 ♀♀, 17 km E of Santa Domingo de los Colorados (Pichincha), burrow, 4 May 1976, D.G.Y. & T. Rogers. Panama. 12 ♂♂, 24 ♀♀, various dates and localities in the Canal Zone, Colon, & Panama Provinces. Trinidad. 1 ♀, Nariva Swamp. Bush Bush Forest, light trap, 2-3 Nov. 1965, T.H.G. Aitken.

*Discussion*: *Lutzomyia nordestina*, a widespread species occurring on both sides of the Andes in Colombia and Ecuador, is often found resting

in animal burrows. There is some evidence indicating that females feed on cold-blooded vertebrates (Tesh et al., 1971a).

I have examined females of an undescribed *Lutzomyia* sp. from Altamira (Para), Brazil (km 164), which resembles that of *nordestina* in most nonsexual and sexual characters but the cibarial armature is quite different. Other than this species, *L. nordestina* does not seem to be closely allied to any other described taxon.

104. *Lutzomyia rangeliana*  
(Fig. 88)

*Phlebotomus rangelianus* Ortiz, 1952: 153 (♂ holotype, Duaca, Lara State, Venezuela). Pifano et al., 1962: 384, 389 (♂, ♀, keyed), 406-407 (♂, ♀, descr., figs.). Leon, 1968: 31 (listed).

*Lutzomyia rangeliana*: Theodor, 1965: 196 (listed). Arjona et al., 1971: 93 (Colombian record). Forattini, 1971a: 101 (listed). Osorno et al., 1972a: 66 (Colombian records). Forattini, 1973: 293 et seq. (gen. review, figs.).

*Distribution*: Panama, Colombia (Bolívar, Magdalena, Tolima), Venezuela, Trinidad.

*Material examined*: Colombia. 3 ♂♂, 5 ♀♀, 10 km SE of Santa Marta (Magdalena), tree trunks, 17 Aug. 1973, D.G.Y. & R.C.W. Panama. 1 ♂, Rio Paya (Darién), tree buttress, 5 July 1958, P. Galindo & A. Quinonez. Trinidad. 10+ ♂♂, 10+ ♀♀, various localities to be treated in a forthcoming paper.

*Discussion*: *Lutzomyia rangeliana*, a little-known, small-eyed sand fly, is treated as an isolated species for the moment because of the female genitalia, especially the spermathecae with the very short, almost

absent, individual sperm ducts. The sac-like spermathecae, cibarial armature and pigment patch of the females, the male genitalia, and palpi of both sexes, however, resemble those of the *verrucarum* group spp., indicating perhaps that *rangeliana* and these species may have evolved from common stock.

Except for *L. nevési* (Damasceno & Arouck), the males of the *verrucarum* group possess a coxite tuft or tufts although this feature may not always be present in taxa which appear to be otherwise closely related. This suggests that *rangeliana* may belong with them when all characters are considered, the male lacking a coxite tuft but having simple parameres, reduced spines on the style, and a subterminal seta like those in the series *serrana* (*verrucarum* group).

105. *Lutzomyia* sp. of Anchicaya  
(Fig. 89)

*Male* (n = 1): Wing length 1.98; width 0.56. Head, mesonotum, lower half of pleura, coxae, and abdominal tergites well pigmented, rest of insect paler. Head height 0.36; width 0.36. Eyes large, separated by 0.11 or by distance = to 6.2 facet diameters. Flagellomere I (0.28 long), 1.1 x length of II + III; ascoids simple, no posterior spurs, on all flagellomeres except last, although difficult to see on two preceding flagellomeres. Length of palpal segments: 1 (0.04), 2 (0.09), 3 (0.14), 4 (0.07), 5 (0.14); palpal sensilla (5) on distal fourth of segment 2. Labrum length 0.21. Cibarium with ca. 20 subequal vertical teeth in 2 irregular rows, some lateral teeth, vestiges of horizontal teeth on sides with a space in middle; chitinous arch nearly complete, diffuse in middle; pigment patch subtriangular, faintly pigmented. Pharynx length



0.19. Pleura with 20 upper and 6-7 lower episternal setae. Length of wing vein sections: *Alpha* (0.54), *beta* (0.19), *delta* (0.15), *gamma* (0.19).

Length of femora, tibiae, and basitarsi: Foreleg, 0.70, 0.99, 0.54; midleg, 0.78, 1.28, 0.74; hindleg, missing. Abdominal sternites apparently entire, lacking nonsclerotized openings. Genitalia: Style (0.12 long) with a proximal isolated spine, 3 large spines at apical third of structure and a small subterminal bristle. Coxite (0.19 long x 0.06 wide), lacking a tuft, deciduous setae mostly strap-like. Paramere simple. Aedeagus (0.10 long), subtriangular, more slender distally. Lateral lobe (0.21 long). Genital pump (0.17 long); each filament 0.37 long or nearly 2.2 x length of pump, filament tips simple, angular, not pointed. Cerci as shown.

*Distribution:* Colombia (Valle).

*Material examined:* Colombia. 1 ♂, Anchicaya Dam (Valle), tree trunk, 9 Aug. 1973, D.G.Y. & R.C.W.

*Discussion:* Although the coxite tuft is lacking, this male may belong in the subgenus *Pintomyia*, confirmation being possible only when complete males and females are discovered. The hind legs are missing from the male on hand; therefore it is impossible to determine whether or not short spines are present on the hind femora.

Figure 87

*Lutzomyia nordestina* -- A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium and pharynx, F. Genital pump and filaments, G. Male genitalia, H. Spermathecae, I. Female wing, J. Male wing, K. Female cibarium.

Male: Curiche, Choco Dept., Colombia

Female: Same locality as male

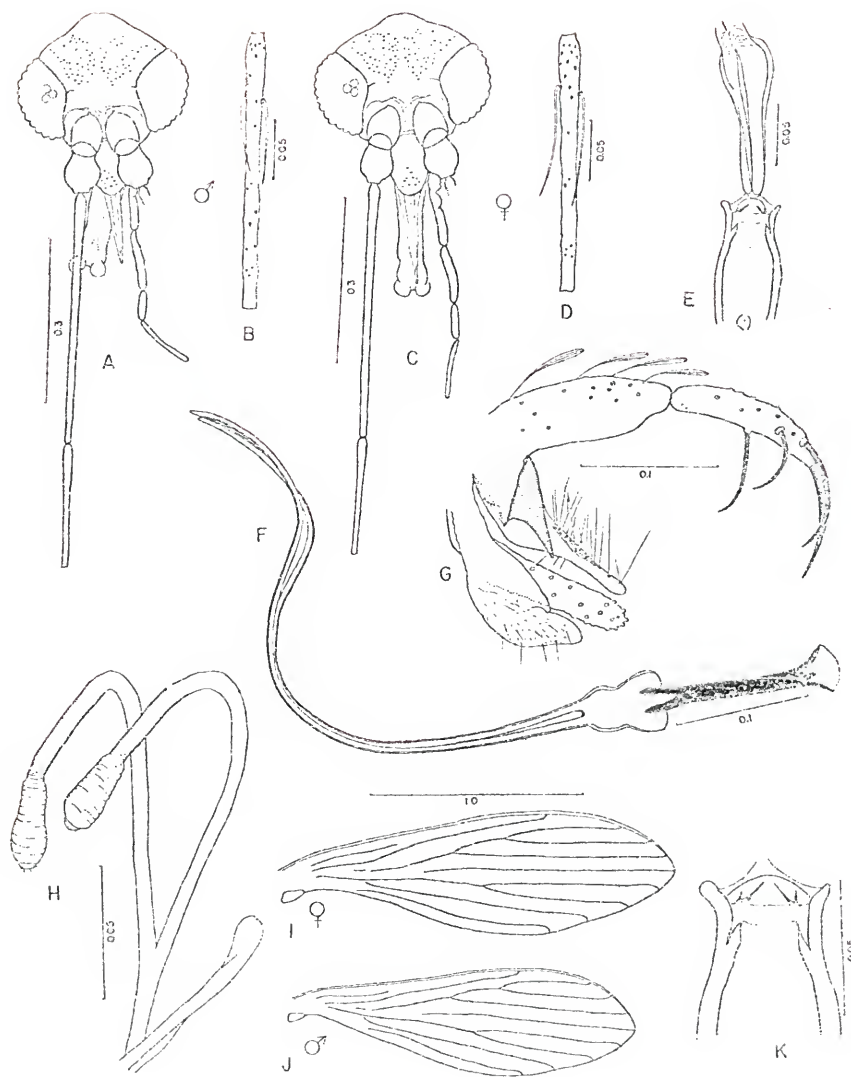


Figure 88

*Lutzomyia rangelliana* -- A. Male head, B. Female cibarium, C. Spermathecae, D. Male genitalia.

Male: Trinidad

Female: Trinidad

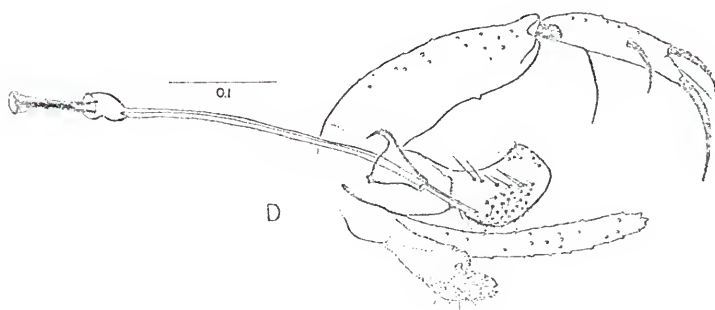
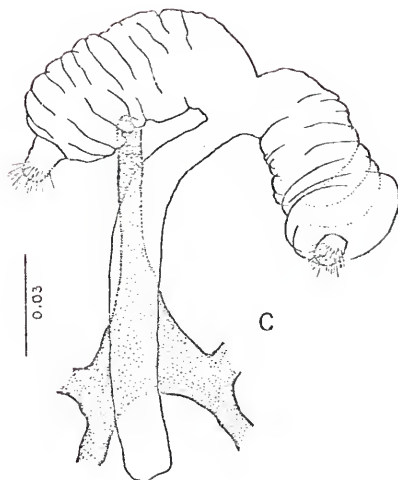
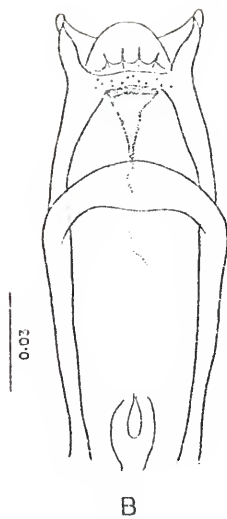
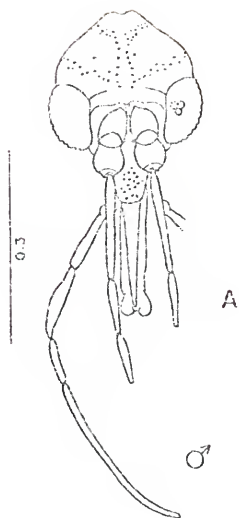
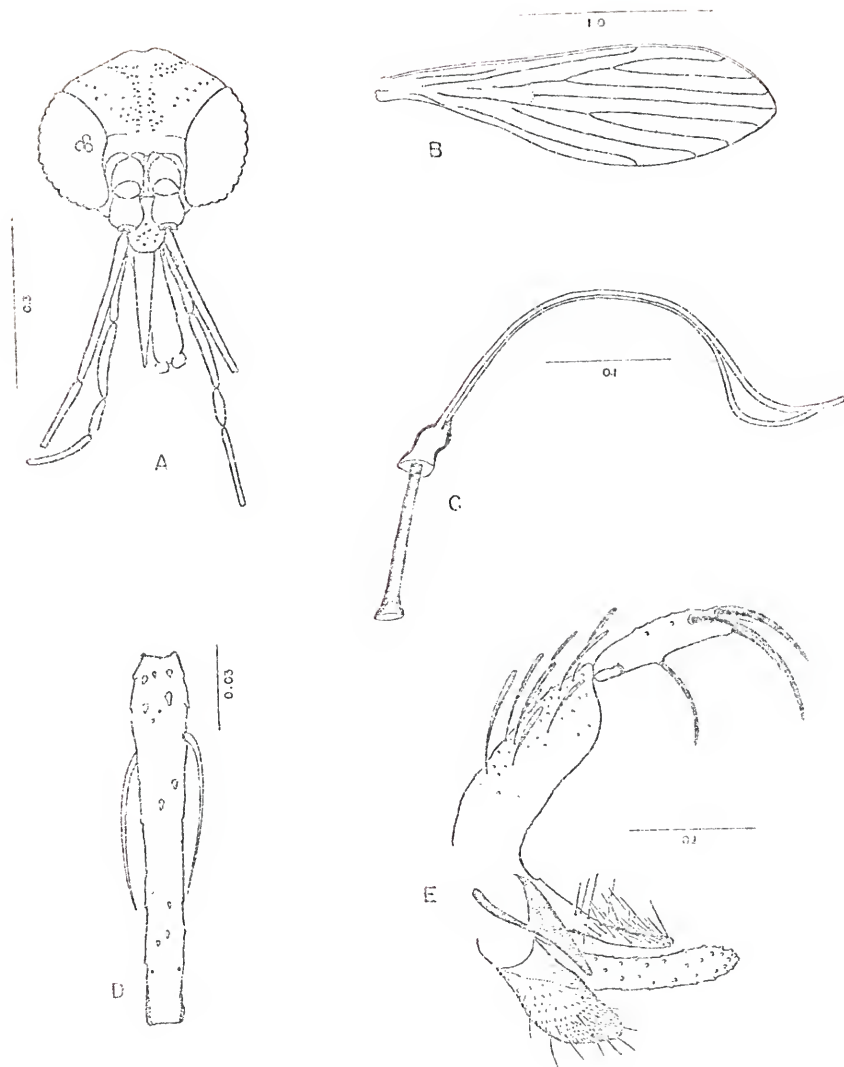


Figure 89

*Lutsumyia* sp. of Anchicaya male -- A. Head, B. Wing, C. Genital pump and filaments, D. Flagellomere II, E. Genitalia.

Male: Anchicaya Dam, Valle Dept., Colombia



SYNOPSIS OF NEW TAXA, SYNONYMS, FEMALE DESCRIPTIONS,  
AND NEW DISTRIBUTION RECORDS

New Taxa

*Sycorax andicola*  
*Sycorax colombiensis*  
*Sycorax fairchildi*  
*Sycorax trispinosa*  
*Lutzomyia* (L.) *marinkellei*  
*Lutzomyia moralesi*  
*Lutzomyia barrettoi majuscula*  
*Lutzomyia* (T.) *hawardi*  
*Lutzomyia* (T.) *cellulana*  
*Lutzomyia* (T.) *saltuosa*  
*Lutzomyia* (P.) *carrerei thula*  
*Lutzomyia* (P.) of Tres Esquinas  
*Lutzomyia* sp. of Pichinde  
*Lutzomyia* sp. of Anchicaya

New Synonyms

*Lutzomyia tintinnabula* = *L. cyrosai*  
*Lutzomyia gasti* = *L. walkeri*

Female Descriptions

*Lutzomyia* (L.) *bifoliata*  
*Lutzomyia* (P.) *hirsuta nicaraguensis*  
*Lutzomyia pilosa*

New Distribution Records

COLOMBIA

*Brumptomyia hamata*  
*Brumptomyia leopoldoi*  
*Lutzomyia baityi*  
*Lutzomyia* (P.) *bispinosa*  
*Lutzomyia carpenteri*  
*Lutzomyia dreisbachi*  
*Lutzomyia* (Pr.) *dyspnea*  
*Lutzomyia isovespertilionis*  
*Lutzomyia migonei*  
*Lutzomyia nuneztovari*  
*Lutzomyia scorzai*



COSTA RICA

*Lutzomyia pia*

CUBA

*Lutzomyia cayennensis*

ECUADOR

*Brumptomyia galindoi*  
*Lutzomyia abuncensis*  
*Lutzomyia aclydifera*  
*Lutzomyia baityi*  
*Lutzomyia* (P.) *bispinosa*  
*Lutzomyia* (P.) *carrerei carrerei*  
*Lutzomyia* (P.) *carrerei thula*  
*Lutzomyia* (P.) *davisi*  
*Lutzomyia dendrophyia*  
*Lutzomyia* (H.) *flaviscutellata*  
*Lutzomyia guyanensis*  
*Lutzomyia hartmanni*  
*Lutzomyia* (P.) *hirsuta hirsuta*  
*Lutzomyia micropyga*  
*Lutzomyia nevesi*  
*Lutzomyia* (P.) *nocticola*  
*Lutzomyia* (N.) *olmesa bicolor*  
*Lutzomyia* (P.) *panarensis*  
*Lutzomyia* (T.) *reburra*  
*Lutzomyia undulata*  
*Lutzomyia walkeri*  
*Lutzomyia* (N.) *yuilli*

GUATEMALA

*Lutzomyia* (N.) *ylephiletor*

HONDURAS

*Lutzomyia evansi*  
*Lutzomyia texana*

PANAMA

*Lutzomyia* (P.) *noctivola*

*Lutzomyia* *rangeli*ans

*Lutzomyia* (P.) *recurva*

PARAGUAY

*Brumptomyia* *galindoi*

# REFERENCES

- Abonnenc, E.
  1948. Phlébotomes de la Guyane Française (XXV). Sur *P. ayrouxi* Barretto et Coutinho, 1940 et *P. paraensis* Costa Lima 1941. Inst. Pasteur Guyane, Pub. No. 177, 4 p.
  1972. Les Phlébotomes de la Région Éthiopienne (Diptera, Psychodidae). Mem. O.R.S.T.O.M., No. 55, 289 p.
- Abonnenc, E. and N. Leger
  1975. Sur une classification rationnelle des diptères Phlebotomidae. Cah. O.R.S.T.O.M. Ser. Ent. Med. Parasit. 14:69-78.
- Abonnenc, E. and D.M. Minter
  1955. Bilingual keys for the identification of sandflies of the Ethiopian Region (French and English). Cah. O.R.S.T.O.M., Ser. Ent. Med., No. 5, 63 p.
- Aitken, T.H.G., J.P. Woodall, A.H.P. de Andrade, G. Bensabath, and R.F. Shope
  1975. Pacui virus, phlebotomine flies and small mammals in Brazil: An epidemiological study. Amer. J. Trop. Med. Hyg. 24: 358-368.
- Aitken, T.H.G., C.B. Worth, and E.S. Tikasingh
  1968. Arbovirus studies in Bush Forest, Trinidad W.I., September 1959-December 1964. Amer. J. Trop. Med. Hyg. 17:253-268.
- Almeida, F.B.
  - 1970a. Flebotomos da Amazônia II -- Sobre ocorrência de anomalias no genitalia masculina em *Lutzomyia anduzei* (Rozeboom, 1942) e *Lutzomyia rorataensis* (Floch and Abonnenc, 1944) (Diptera, Psychodidae). Bol. INPA Path. Trop. 1:1-4.
  - 1970b. Flebotomos da Amazônia I -- Sobre a presença de *Lutzomyia anduzei* (Rozeboom, 1942) no Brasil (Diptera, Psychodidae). Bol. INPA Path. Trop. 3:1-16.
- Anduze, P.J., F. Pifano, and E. Vogelsang
  1947. Nomina de los atropodos vulnerantes conocidos actualmente en Venezuela. Bol. Ent. Venez. (num. extra), 1-16.
- Antunes, P.C.A.
  1937. Informe sobre una investigación entomológica realizada en Colombia. Rev. Fac. Med. Univ. Nac. Colomb. 6:3-29.

- Arjona, A.C., E. Osorno-Mesa, and J.P. Marquez  
1971. Contribución al estudio epidemiológico del kala-azar en Colombia. Rev. Fac. Med. Univ. Nac. Colomb. 37:90-94.
- Arenabe, R.  
1960. Los *Phlebotomus* del Ecuador. Rev. Ecuat. Hig. Med. Trop. 17:155-159.
- Barreto, P.  
1969. Artropodos hematófagos del Río Raposo, Valle, Colombia. IV. Psychodidae. Caldasia 10:459-472.
- Barretto, M.P.  
1941. Morfologia dos ovos, das larvas e pupas de alguns flebotomos de São Paulo. Anais Fac. Med. Univ. S. Paulo 17:357-427.  
1946a. Sobre a sinonímia de flebotomos Americanos (Diptera, Psychodidae). Anais Fac. Med. Univ. S. Paulo 22:1-27.  
1946b. Sobre a sinonímia de flebotomos Americanos (Diptera, Psychodidae). Primeira nota. Rev. Brasil. Biol. 6:527-536.  
1946c. Uma nova espécie de flebótomo do Estado de Goiás, Brasil, e chave para determinação das espécies afins (Diptera: Psychodidae). Rev. Brasil. Biol. 6:427-434.  
1946d. Uma nova espécie de flebótomo da Colombia e chave para a determinação das espécies afins. Anais Fac. Med. Univ. S. Paulo 22:279-293.  
1947. Catálogo dos flebotomos Americanos. Arch. Zool. Est. S. Paulo 5:177-242.  
1950a. Chaves para os flebotomos Brasileiros (Diptera, Psychodidae). Anais Fac. Med. Univ. S. Paulo 25:101-120.  
1950b. Duas novas espécies de flebotomos Brasileiros (Diptera, Psychodidae). Folia Clin. Biol. 16:143-149.  
1951. Nova contribuição para o estudo da distribuição geográfica dos flebotomos Americanos (Diptera, Psychodidae). Arch. Hyg. Saude Públ. 15:211-226.  
1953. Sobre a sistemática da subfamília Phlebotominae Rondani (Diptera, Psychodidae). Terceira nota. Folia Clin. Biol. 20:209-214.  
1954. Sobre a sinonímia de flebotomos Americanos (Diptera, Psychodidae). Quarta nota. Folia Clin. Biol. 21:121-126.  
1955a. Sobre a sistemática da subfamília Phlebotominae Rondani. Rev. Brasil. Ent. 3:173-190.

Barretto, M.P.

- 1957b. Nova espécie de flebótomo do Brasil (Diptera, Psychodidae). Rev. Hosp. Clin. S. Paulo 10:247-249.
1956. Sobre o genero *Sycorax* Hal., com as descrições de duas novas espécies do Brasil (Diptera, Psychodidae). Folia Clin. Biol. 26:71-78.
1961. Introdução ao estudo systemático dos flebotomíneos Americanos (Diptera, Psychodidae). Thesis, Fac. Med. Rebeirão Prêto, 171 p.
1962. Novas subgeneros de *Lutzomyia* França, 1924 (Psychodidae, subfamília Phlebotominae). Rev. Inst. Med. Trop. S. Paulo 4:91-100.
1966. Estudos sobre flebotomíneos Americanos. I. Notas sobre espécies de *Lutzomyia* Franca, subgenero *Psychodopygus* Mangabeira, 1941, com a descrição de uma nova especie (Diptera, Psychodidae). Papeis Dep. Zool. S. Paulo 18: 133-146.

Barretto, M.P. and J.O. Coutinho

1940. Contribuição ao conhecimento dos flebótomos de São Paulo. II. Descrição do macho de *Phlebotomus lima* Fonseca, 1935 e de duas novas espécies: *Phlebotomus ayrozai* e *P. amarali* (Diptera, Psychodidae). Anais Fac. Med. Univ. S. Paulo 16:127-139.
1943. Contribuição para o conhecimento dos flebótomos de São Paulo. VIII. Descrição de fema de *P. ayrozai* Barretto and Coutinho, 1940 e do macho de *P. basispinosus* n.sp. (Diptera, Psychodidae). Rev. Brasil. Biol. 3:183-189.

Barretto, M.P. and J.P. Duret

1953. Uma nova espécie de flebótomo da República Argentina: *Phlebotomus microcephalus*, n.sp. (Diptera, Psychodidae). Papeis Dep. Zool. S. Paulo 11:341-344.

Barretto, M.P., A.V. Martins, and J. Pellegrino

1956. Notas sobre flebotomíneos do nordeste do Estado de Minas Gerais, com as descrições de duas espécies novas (Diptera, Psychodidae). Folia Clin. Biol. 26:47-56.

Barretto, M.P. and H. Zago Filho

1956. Flebótomos encontrados em Petropolis, R.J., com a descrição de uma nova espécie (Diptera, Psychodidae). Rev. Brasil. Ent. 5:177-185.

Biagi, A.M., F.H. Beltran, and F.F. Biagi

1966. Nuevos conocimientos sobre los flebotomos del area endemica de leishmaniasis cutanea en Yucatan. Rev. Invest. Salud Públ., Mex. 26:139-153.

- Biancas, F.  
1959-1960. Notas sobre flebotomos Peruanos. Enumeración de las especies de flebotomos encontrados en el Peru y descripción de una especie nueva, *Phlebotomus gorbitzi* n.sp. (Diptera, Psychodidae). Rev. Med. Exp., Lima 13:125-134.
- Borror, D.J., D.M. DeLong, and C.A. Triplehorn  
1976. An introduction to the study of insects. Holt, Rinehart and Winston, N.Y. 852 p.
- Brown, K.S., Jr.  
1975. Geographical patterns of evolution in Neotropical Lepidoptera. Systematics and derivation of known and new Heliconiini (Nymphalidae: Nymphalinae). J. Ent. (B) 44:201-242.
- Bruijning, C.F.A.  
1957. Man-biting sandflies in endemic leishmaniasis area of Surinam. Doc. Med. Geogr. Trop. 9:229-236.
- Buck, A.A., Sasaki, T.T., and R.I. Anderson  
1968. Health and disease in four Peruvian villages. Contrasts and Epidemiology. The Johns Hopkins Press, Baltimore. 142 p.
- Calderon, L.  
1973. *Phlebotomus townsendi*, Oritz, 1959, en una zona endemica de leishmaniasis tegumentaria del Estado Merida, Venezuela. Acta Cient. Venez. 24:87.
- Calisher, C.H., R.G. McLean, G.C. Smith, D.M. Szmyd, D.J. Muth, and J.S. Laznick  
1977. Rio Grande -- A new phlebotomus fever group virus from south Texas. Amer. J. Trop. Med. Hyg. 26 (in press).
- Gailan, E. McC  
1947. A note on *Phlebotomus trinidadensis* Newstead (Dipt., Psychodidae). Rev. Ent. 18:215-218.
- Carvalho, M. and I.A. Sherlock  
1954. Estudo morfológico sobre as pupas de Phlebotominae (Diptera, Psychodidae). Rev. Brasil. Malar. Doeng. Trop. 16:311-329.
- Gausey, O.R. and R.G. Damasceno  
1945. Estudo sobre *Phlebotomus* no Vale Amazônico. Parte IV. Descrição de *F. cerqueirai*, *F. dreisbachi*, *F. meirai* e *F. ferreirai* (Diptera-Psychodidae). Mem. Inst. Oswaldo Cruz 42:645-660.  
  
1948. Estudo sobre *Phlebotomus* no Vale Amazônico. Parte II. Descrição de *F. dunhami*, *F. melloi* e *F. wagleyi*. Rev. Ser. Esp. Saúde Públ. 1:625-640.
- Chenotlis, B.N.  
1971. Female gynandromorphs of *Lutzomyia trinidadensis* Newstead from Panama. J. Med. Ent. 8:459.

Chanlotis, B.N.

- 1974a. Sugar feeding behavior of *Lutzomyia trapidoi* (Diptera: Psychodidae) under experimental conditions. J. Med. Ent. 11:73-79.
- 1974b. Use of external characters for rapid identification of phlebotomine sandflies in vector studies. J. Med. Ent. 11:501.
- 1975. A new method for rearing *Lutzomyia trapidoi* (Diptera: Psychodidae) with observations on the development and behavior in the laboratory. J. Med. Ent. 12:183-188.

Chanlotis, B.N. and M.A. Correa

- 1974. Comparative flying and biting activity of Panamanian phlebotomine sandflies in mature forest and adjacent open space. J. Med. Ent. 11:115-116.

Chanlotis, B.N., M.A. Correa, R.B. Tesh, and K.M. Johnson

- 1971b. Daily and seasonal man-biting activity of phlebotomine sandflies in Panama. J. Med. Ent. 8:415-420.
- 1974. Horizontal and vertical movement of phlebotomine sandflies in a Panamanian rain forest. J. Med. Ent. 11:369-375.

Chanlotis, B.N., J.M. Neely, M.A. Correa, R.B. Tesh, and K.M. Johnson

- 1971a. Natural population dynamics of phlebotomine sandflies in Panama. J. Med. Ent. 8:339-352.

Chanlotis, B.N., R.B. Tesh, M.A. Correa, and K.M. Johnson

- 1972. Diurnal resting sites of phlebotomine sandflies in a Panamanian tropical forest. J. Med. Ent. 9:91-98.

Christensen, H.A.

- 1972a. Checklist of the phlebotomine sand flies (Diptera: Psychodidae) of Panama including two species not previously reported. Mosquito News 32:88-89.
- 1972b. Colonization of *Lutzomyia trinidadensis* and *L. verpertilionis* (Diptera: Psychodidae). Ann. Ent. Soc. Amer. 65:683-686.

Christensen, H.A. and G.E. Fairchild

- 1971. *Lutzomyia tintinnabula* n.sp. (Diptera: Psychodidae) from Panama. J. Med. Ent. 8:301-303.

Christensen, H.A. and A. Herrero

- 1973. Attractiveness of sentinel animals to vectors of leishmaniasis in Panama. Amer. J. Trop. Med. Hyg. 22:578-584.
- 1976. Neotropical sand flies (Diptera: Psychodidae), invertebrate hosts of *Endotrypanum schaudinni* (Kinetoplastida: Trypanosomatidae). J. Med. Ent. 13:299-303.

- Christensen, H.A., A. Herrer, and G.B. Fairchild  
1971. Pyloric armature of New World phlebotomine sandflies (Diptera, Psychodidae). J. Med. Ent. 8:116-119.
- Christensen, H.A., A. Herrer, and S.R. Telford, Jr.  
1969. *Leishmania braziliensis* s. lat., isolated from *Lutzomyia panamensis* in Panama. J. Parasit. 55:1090-1091.
1972. Enzootic cutaneous leishmaniasis in eastern Panama. II: Entomological investigations. Ann. Trop. Med. Parasit. 66:55-66.
- Christophers, S.R.  
1960. *Aedes aegypti* (L.) the yellow fever mosquito. Univ. Press Cambridge. 739 p.
- Costa Lima, A.  
1932. Sobre os flebotomos Americanos. Mem. Inst. Oswaldo Cruz 26:15-69.
1941. Uma nova *Flebotomus* da Amazônia e considerações relativas às espécies afins (Diptera: Psychodidae). Acta Med., Rio de Janeiro 7:3-19.
- Courmes, E., A. Escudie, P. Fauran, and A. Monnerville  
1966. Premier cas autochtone de leishmaniose viscerale humaine à la Guadeloupe. Bull. Soc. Path. Exot. 59:217-225.
- Coutinho, J.O.  
1939. Nota sobre flebotomos sulamericanos. Bol. Biol. Lab. Parasit. Fac. Med. S. Paulo 4:181-183.
- D'Alessandro, A. and P. Barreto  
1971. Distribution of triatomine-transmitted trypanosomiasis in Colombia and new records of the bugs and infections. J. Med. Ent. 8:159-172.
- Damasceno, R.G. and R. Arouck  
1949. Estudos sobre *Flebotomus* no Vale Amazônico. Parte VII. Descrição de uma nova espécie, *Phlebotomus serranus* (Diptera, Psychodidae). Rev. Ser. Esp. Saúde Públ. 2: 843-848.
- Damasceno, R.G., R. Arouck, and O.R. Causey  
1949. Estudos sobre *Flebotomus* no Vale Amazônico. Parte VI. Contribuição ao conhecimento da distribuição geográfica e da incidência por tipo de capture de 64 espécies identificadas. Revta Ser. Esp. Saúde Públ. 2:817-842.
- Damasceno, R.G. and O.R. Causey  
1944. Estudo sobre *Flebotomus* no Vale Amazônico. Parte I. Descrição de *F. marajoensis*, *F. pilosus*, *F. souzacastrói* e *F. christophersoni* (Diptera: Psychodidae). Mem. Inst. Oswaldo Cruz 41:339-350.



- Damasceno, R.G., O.R. Causey, and R. Aroack  
1945. Estudo sobre *Phlebotomus* no Vale Amazônico. Parte V. Descrição de *P. williamsi*, *P. deane*i, *P. carvalhoi*, *P. lope*si, *P. castanheirai*, *P. jaccisi*, *P. baityi* e *P. campbelli* (Diptera - Psychodidae). Mem. Inst. Oswaldo Cruz 43:1-30.
- Dampf, A.  
1938. Un nuevo *Phlebotomus* (Insecta, Diptera, fam. Psychodidae) procedente de Texas, E.U.A. Ann. Esc. Nac. Cien. Biol., Mex. 1:119-122.  
1947. Notas sobre flebotomidos Americanos (Diptera, Psychod.). Rev. Ent. 18:296-316.
- Davis, N.T.  
1967. Leishmaniasis in the Sudan Republic. 28. Anatomical studies on *Phlebotomus orientalis* Parrot and *P. papatasi* Scopoli (Diptera: Psychodidae). J. Med. Ent. 4:50-65.
- Deane, L.M. and M.P. Deane  
1957. Observações sobre abrigos e criadouros de flebotomos no nordeste do Estado do Ceara. Rev. Brasil. Malar. Doeng. Trop. 9:225-246.
- Desportes, C.  
1942. *Forcipomyia velox* Winn. et *Sycorax silacea* Curtis, vecteurs d'*Icosiella neglecta* (Diesing), filaire commune de la grenoville verte. Ann. Parasit. Hum. Comp. 19:53-68.
- Díaz Nájera, A.  
1963. *Phlebotomus* de Mexico: Descripción de la hembra de *Ph. (Brumptomyia) galindoi* F. and H., 1947; datos de distribución geográfica (Diptera, Psychodidae). Rev. Inst. Salubr. Enferm. Trop., Méx. 23:193-199.
- Disney, R.H.L.  
1966. A trap for phlebotomine sandflies attracted to rats. Bull. Ent. Res. 56:445-451.
- Duckhouse, D.A.  
1972. Psychodidae (Diptera, Nematocera) of south Chile, subfamilies Sycoracinae and Trichomyiinae. Trans. Roy. Ent. Soc. Lond. 124:231-268.  
1973. A catalogue of the Diptera of the Americas south of the United States. 6A. Family Psychodidae, subfamilies Bruchomyiinae, Trichomyiinae, Sycoracinae, and Psychodinae. Mus. Zool. Univ. S. Paulo. 29 p.
- Dyar, H.G.  
1929. The present knowledge of the American species of *Phlebotomus* Rondani (Diptera, Psychodidae). Amer. J. Hyg. 10:112-124.

Eldridge, B.F. and G.B. Fairchild

1973. A survey to assess potential human disease hazards along proposed sea level canal routes in Panama and Colombia. II. Geography of proposed routes. Milit. Med. 138:271-275.

Eldridge, B.F., D.C. Young, and R.R. Gerhardt

1973. A survey to assess potential human disease hazards along proposed sea level canal routes in Panama and Colombia. III. Survey methods. Milit. Med. 138:340-344.

Espinal, L.S.

1968. Visión ecológica del Valle del Cauca. Univ. del Valle, Cali. 105 p.

Espinzi, L.S. and E. Montenegro

1963. Formaciones vegetales de Colombia. Inst. Geografico d'Agustin Codazzi, Bogota. 201 p.

Fairchild, G.B.

1943. An annotated list of the blood-sucking insects, ticks and mites known from Panama. Amer. J. Trop. Med. 23:569-591.

1953. A note on *Hertigia hertigi* Fchld. and description of the female. Proc. Ent. Soc. Wash. 55:101-102.

1955. The relationships and classification of the Phlebotominae (Diptera, Psychodidae). Ann. Ent. Soc. Amer. 48:182-196.

Fairchild, G.B. and M. Hertig

- 1947a. Notes on the *Phlebotomus* of Panama. I. The subgenus *Bursiptomyia* França and Parrot 1921. Ann. Ent. Soc. Amer. 40:610-616.

- 1947b. Notes on the *Phlebotomus* of Panama (Diptera, Psychodidae). II. Descriptions of three new species. Ann. Ent. Soc. Amer. 40:617-622.

- 1948a. Notes on the *Phlebotomus* of Panama (Diptera, Psychodidae). III. *P. cruciatus*, *trinidadensis* and *gomezi*. Ann. Ent. Soc. Amer. 41:247-257.

- 1948b. Notes on the *Phlebotomus* of Panama (Diptera, Psychodidae). IV. *P. atroclavatus* Knab, *P. cayennensis* Floch and Abonnenc, *P. chiapanensis* Dampf and some related forms from the West Indies and Mexico. Ann. Ent. Soc. Amer. 41:455-467.

- 1948c. An improved method for mounting small insects. Science 108:20-21.

1950. Notes on the *Phlebotomus* of Panama (Diptera, Psychodidae). VI. *Phlebotomus shannoni* Dyar and related species. Ann. Ent. Soc. Amer. 43:523-533.

Fairchild, G.B. and M. Hertig

- 1951a. Notes on the *Phlebotomus* of Panama (Diptera, Psychodidae). VII. The subgenus *Shannonomyia* Pratt. Ann. Ent. Soc. Amer. 44:399-421.
- 1951b. Notes on the *Phlebotomus* of Panama (Diptera, Psychodidae). VIII. Two new species of *Warileya*. Ann. Ent. Soc. Amer. 44:422-429.
1952. Notes on the *Phlebotomus* of Panama (Diptera, Psychodidae). XI. Descriptions of seven new species. Ann. Ent. Soc. Amer. 45:505-528.
- 1953a. Notes on the *Phlebotomus* of Panama (Diptera, Psychodidae). X. *P. aragaoi*, *P. barrattoi* and two new species. Ann. Ent. Soc. Amer. 46:21-34.
- 1953b. Notes on the *Phlebotomus* of Panama (Diptera, Psychodidae). XI. The male of *P. cruciatus* Coq. and notes on related species. Ann. Ent. Soc. Amer. 46:373-385.
1956. Notes on the *Phlebotomus* of Panama (Diptera, Psychodidae). XII. The group *anthophorus* with descriptions of four new species from Panama and Mexico. Ann. Ent. Soc. Amer. 49:307-312.
1957. Notes on the *Phlebotomus* of Panama (Diptera, Psychodidae). XIII. The *vesator* group with descriptions of new species from Panama and California. Ann. Ent. Soc. Amer. 50: 325-334.
- 1958a. Notes on the *Phlebotomus* of Panama (Diptera, Psychodidae). XIV. *P. vespertilionis* and related species. Ann. Ent. Soc. Amer. 51:509-516.
- 1958b. Notes on the *Phlebotomus* of Panama. XV. Four apparently new synonymies (Diptera, Psychodidae). Proc. Ent. Soc. Wash. 60:203-205.
1959. Geographic distribution of the *Phlebotomus* sandflies of Central America (Diptera: Psychodidae). Ann. Ent. Soc. Amer. 52:121-124.
- 1961a. Three new species of *Phlebotomus* from Mexico and Nicaragua (Diptera: Psychodidae). Proc. Ent. Soc. Wash. 63:22-28.
- 1961b. Notes on the *Phlebotomus* of Panama (Diptera, Psychodidae). XVI. Descriptions of new and little-known species from Panama and Central America. Ann. Ent. Soc. Amer. 54:237-255.

Fairchild, G.B. and O. Theodor

1971. On *Lutzomyia flaviscutellata* (Mangabeira) and *L. olmeca* (Vargas and Díaz-Najera) (Diptera: Psychodidae). J. Med. Ent. 8:153-159.

Fairchild, G.B. and H. Trapido

1950. The West Indian species of *Phlebotomus* (Diptera, Psychodidae).  
Ann. Ent. Soc. Amer. 43:405-417.

Fauran, P.

1960. Note sur la morphologie de *Phlebotomus brachipybus*,  
*P. campbelli*, *P. carvalhoi*, *P. furiasi*, *P. tuberculatus*  
(Diptera, Psychodidae), signales pour la premiere fois en  
Guyane. Arch. Inst. Pasteur Guyane, Pub. No. 460, 10 p.

Fauran, P., F. Courmes, and R. Mille

1966. Note sur la présence en Martinique de *Phlebotomus atroclavatus*  
(Diptera: Psychodidae). Bull. Soc. Path. Exot. 59:904-908.

Floch, H. and E. Abonnenc

- 1941a. Phlébotomes de la Guyane Française. Inst. Pasteur Guyane,  
Pub. No. 15, 22 p.
- 1941b. Phlébotomes de la Guyane Française - II. Inst. Pasteur  
Guyane, Pub. No. 28, 16 p.
- 1942a. Phlébotomes de la Guyane Française - III. Sur *P. intermedius*  
Lutz & Neiva, 1912. Inst. Pasteur Guyane, Pub. No. 30, 16 p.
- 1942b. Phlébotomes de la Guyane Française - IV. Inst. Pasteur  
Guyane, Pub. No. 38, 15 p.
1943. Phlébotomes de la Guyane Française - V. Inst. Pasteur  
Guyane, Pub. No. 61, 30 p.
- 1944a. Phlébotomes de la Guyane Française - VIII. Description de  
cinq espèces nouvelles. Inst. Pasteur Guyane, Pub. No. 81,  
18 p.
- 1944b. Phlébotomes de la Guyane Française - IX. Description de la  
female de *P. fluvialilis* et trois espèces nouvelles. Inst.  
Pasteur Guyane, Pub. No. 83, 11 p.
- 1944c. Phlébotomes de la Guyane Française - X. Sur les femelles a  
5<sup>e</sup> segment des palpes court. Description du male de  
*P. anduzei*. Inst. Pasteur Guyane, Pub. No. 88, 22 p.
- 1944d. Phlébotomes de la Guyane Française - XI. Sur cinq males  
recontres pour la 1<sup>re</sup> fois et description de quatre espèces  
nouvelles. Inst. Pasteur Guyane, Pub. No. 90, 24 p.
- 1945a. Description d'un phlébotome nouveau de la Guadeloupe. Inst.  
Pasteur Guyane, Pub. No. 96, 4 p.
- 1945b. Phlébotomes de la Guyane Française - XIII. Description de  
deux nouvelles females. Inst. Pasteur Guyane, Pub. No. 98,  
4 p.

- 1945c. Phlébotomes de la Guyane Française - XIV. Table d'identification des phlébotomes femelles d'Amérique. Inst. Pasteur Guyane, Pub. No. 100, 22 p.
1946. Phlébotomes de la Guyane Française - XVII. *P. maripaensis* n.sp. et *P. sp.* de Maripa. Inst. Pasteur Guyane, Pub. No. 140, 6 p.
- 1947a. Cléf d'identification de 140 phlébotomes males du nouveau continent. Bol. Ent. Venez. 6:1-24.
- 1948a. Phlébotomes du Venezuela - Sur la femelle de *P. cayennensis* Floch & Abonnenc, 1941. Inst. Pasteur Guyane, Pub. No. 166, 3 p.
- 1948b. Phlébotomes du Venezuela - II. Description de *P. atroclavatus* Knab, 1913, de *P. evansi* Nunez-Tovar, 1924, de *P. cayennensis* Floch & Abonnenc, 1941, de *P. baduelensis* Floch & Abonnenc, 1944, de *P. venezuelensis* n.sp. et de *P. zuliaensis* n.sp. Inst. Pasteur Guyane, Pub. No. 178, 24 p.
- 1950a. Phlébotomes du Venezuela - III. Description d'une espèce nouvelle: *Phlebotomus lichyi*. Inst. Pasteur Guyane, Pub. No. 208, 5 p.
- 1950b. Sur la synonymie de quelques phlébotomes Sud-Américains. Inst. Pasteur Guyane, Pub. No. 212, 13 p.
1952. Dipteres phlébotomes de la Guyane et des Antilles Françaises. Faune de L'Union Français, no. 14, 207 p.

Floch, H. and R. Chassignet

- 1947a. Phlébotomes de la Guyane Française - XIX. *P. colas-belcourti* n.sp. Inst. Pasteur Guyane, Pub. No. 152, 3 p.
- 1947b. Phlébotomes de la Guyane Française - XX. *P. dendrophyllus* Mangabeira, 1942, et *P. quadrispinosus* n.sp. Inst. Pasteur Guyane, Pub. No. 155, 5 p.
- 1947c. Phlébotomes de la Guyane Française - XXI. *P. abbonenci* n.sp. Inst. Pasteur Guyane, Pub. No. 157, 3 p.
1948. Phlébotomes de la Guyane Française - XXIV. Description de deux femelles nouvelles. Inst. Pasteur Guyane, Pub. No. 170, 6 p.

Floch, H. and R. Kramer

1955. Sur les phlébotomes du Venezuela: *P. lichyi* Floch & Abonnenc, 1950, *P. vexillarius* Fairchild and Hertig, 1952, et *P. foliatus* Mirsa & Oritz, 1953. Bull. Soc. Path. Exot. 59:387-391.

Forattini, O.P.

1954. O segundo esternito em algumas espécies de flebótomos do Brasil (Diptera, Psychodidae). *Folia Clin. Biol.* 21:213-218.
1960. Notas sobre *Phlebotomus* do Território do Amapá, Brasil (Diptera, Psychodidae). *Studia Ent.* 3:467-480.
- 1971a. Sobre a classificação da subfamília Phlebotominae nas Américas (Diptera, Psychodidae). *Papeis Dep. Zool. S. Paulo* 24:93-111.
- 1971b. Nota sobre *Psychodopygus squamiventris* (Lutz & Neiva, 1912) e espécies afins (Diptera, Psychodidae). *Rev. Saúde Públ. S. Paulo.* 5:151-154.
- 1971c. Nota sobre *Psychodopygus parazensis* (Lima, 1941) (Diptera, Psychodidae). *Studia Ent.* 14:173-176.
1973. Entomologia Médica. IV. Psychodidae. Phlebotominae. Leishmanioses. Bartonelose. Edgard Blucher, S. Paulo. 658 p.

Forattini, O.P. and E.A.B. Galati

1977. Description of the female of *Psychodopygus ayrozai* (Barretto and Coutinho) (Diptera: Phlebotominae). *Proc. Ent. Soc. Wash.* 79:25-27.

Forattini, O.P. and M.R. dos Santos

1955. Novas observações em regiões endêmicas de leishmaniose tegumentar Americana nos estados de São Paulo e Mato Grosso, Brasil. *Rev. Clin. S. Paulo* 1-3:13-20.

Fraiha, H., J.J. Shaw, and R. Lainson

- 1970a. Phlebotominae Brasileiros. I. Descrição de uma nova espécie de *Brumptomyia* e chave para identificação dos machos das espécies do gênero. *Rev. Brasil. Biol.* 30:465-470.
- 1970b. *Lutzomyia falciiformis* (Floch & Abonnenc, 1944) sinônimo de *Lutzomyia monstruosa* (Floch & Abonnenc, 1944). *Rev. Saúde Públ. S. Paulo* 4:215-216.
1971. Phlebotominae Brasileiros. II. *Psychodopygus wellcomei*, nova espécie entropófila de flebótomo do grupo *squamiventris*, do sul do Estado de Pará, Brasil (Diptera, Psychodidae). *Mem. Inst. Oswaldo Cruz* 69:489-500.

Fraiha, H., R.D. Ward, C.A. Loureiro, and G.M. Soares

1974. Flebotomídeos Brasileiros. IV. Nota sobre *Psychodopygus chogasi* (Costa Lima, 1941) (Diptera: Phlebotomidae). *Rev. Brasil. Biol.* 34:89-91.

Fraiha, H., R.D. Ward, J.J. Shaw, and R. Lainson

1978. Fauna antropológica de flebótomos da rodovia transamazônica, Brasil. *Bull. Pan-Am. Hlth. Organ.* (in press).

- França, C.  
1920. Observations sur le genre *Phlebotomus*. II. *Phlebotomus* du Nouveau Monde (Phlébotomes du Brésil et du Paraguay). Bull. Soc. Port. Sci. Nat. 8:215-236.
- Calliard, H.  
1934. Un phlébotome nouveau de Mexique *Phlebotomus yucatanensis* n.sp. Ann. Parasit. Hum. Comp. 12:1-7.
- Garnham, P.C.C.  
1962. Cutaneous leishmaniasis in the New World with special reference to *Leishmania mexicana*. Sci. Rep. Inst. Super. Sanita. 2:76-82.
- Garnham, P.C.C. and D.J. Lewis  
1959. Parasites of British Honduras with special reference to leishmaniasis. Trans. Roy. Soc. Trop. Med. Hyg. 53:12-40.
- Gomes, A.C.  
1975. Transmissão da leishmaniose tegumentar americana. Thesis, Dep. Fac. Saúde Públ. Univ. S. Paulo. 65 p.
- Gressitt, J.L. and M.K. Gressitt  
1962. An improved Malaise trap. Pacif. Insects 4:87-90.
- Guittton, N. and I.A. Sherlock  
1959. Descrição das fases imaturas do Lutz & Neiva, 1912 (Diptera, Psychodidae). Rev. Brasil. Biol. 29:383-389.
- Haffer, J.  
1967. Speciation in Colombian forest birds west of the Andes. Amer. Mus. Novit. No. 2294, 57 p.  
1974. Avian speciation in tropical South America. Nuttall Ornithological Club, Pub. 14, Harvard Univ., Cambridge. 390 p.
- Hanson, W.J.  
1961. The breeding places of *Phlebotomus* in Panama (Diptera, Psychodidae). Ann. Ent. Soc. Amer. 54:317-322.  
1968. The immature stages of the subfamily Phlebotominae in Panama (Diptera, Psychodidae). Ph.D. Thesis, Univ. Kansas. 104 p. Univ. Microfilms, Ann Arbor, Mich. (Diss. Abstr. 68-17,390).
- Henriquez, L.C.E., E. Rasi, and L. Garcia  
1970. *Phlebotomus (Lutzomyia) longipalpis* Lutz & Neiva, 1912 (Diptera: Psychodidae) en foco de kala-azar del oriente medio venezolano. Rev. Venez. Sanid. Asist. Soc. 35:761-768.
- Herrer, A. and H.A. Christensen  
1976a. Epidemiological patterns of cutaneous leishmaniasis in Panama. I. Epidemics among small groups of settlers. Ann. Trop. Med. Parasit. 70:59-65.

Herrer, A. and H.A. Christenson

1976b. Epidemiological patterns of cutaneous leishmaniasis in Panama. III. Endemic persistence of the disease. Am. J. Trop. Med. Hyg. 25:54-58.

1976c. Natural cutaneous leishmaniasis among dogs in Panama. Am. J. Trop. Med. Hyg. 25:59-63.

Herrer, A., H.A. Christensen, and R.J. Beumer

1976. Epidemiological patterns of cutaneous leishmaniasis in Panama. II. Incidental occurrence of cases in non-endemic settlements. Ann. Trop. Med. Parasit. 70:67-71.

Herrer, A., S.R. Telford, Jr., and H.A. Christensen

1971. Enzootic cutaneous leishmaniasis in eastern Panama. I. Investigation of the infection among forest mammals. Ann. Trop. Med. Parasit. 65:349-358.

Hertig, M. and G.B. Fairchild

1950. Notes on the *Phlebotomus* of Panama (Diptera, Psychodidae). V. The second sternite as a taxonomic character. Proc. Ent. Soc. Wash. 52:91-95.

Hertig, M. and E. McConnell

1953. Experimental infection of Panamanian *Phlebotomus* sandflies with *Leishmania*. Exp. Parasit. 14:92-106.

Holdridge, L.R.

1967. Life zone ecology. Trop. Sci. Center, San Jose, Costa Rica. 266 p.

Jones, A.D.

1938. On the antennal musculature in insects and other arthropods. Quart. J. Microscop. Sci. 81:273-320.

Intermill, R.W. and W.B. Muller

1976. New distributional records for *Lutzomyia gomezi* (Nitzulescu) and *L. chitopenensis* (Dampf) from Honduras. Mosquito News 36:543.

Jaramillo, J.R.

1943. Contribucion al estudio de la bartonellosis en Colombia (enfermedad de carrion). Medicina, Bogotá 5:158-182.

Johnson, P.T. and M. Hertig

1961. The rearing of *Phlebotomus* sandflies (Diptera: Psychodidae). II. The development and behavior of Panamanian sandflies in laboratory culture. Ann. Ent. Soc. Amer. 54:764-776.

1979. Behavior of *Leishmania* in Panamanian phlebotomine sandflies fed on infected animals. Exp. Parasit. 27:281-300.



- Johnson, P.L., E. McConnell, and M. Hertig  
1962. Natural and experimental infections of leptomonad flagellates in Panamanian *Phlebotomus* sandflies. J. Parasit. 48:158.
1963. Natural infections of leptomonad flagellates in Panamanian *Phlebotomus* sandflies. Exp. Parasit. 14:107-122.
- Killick-Kendrick, R., A.J. Leane, and P.D. Ready  
1977. The establishment, maintenance and productivity of a laboratory colony of *Lutzomyia longipalpis* (Diptera: Psychodidae). J. Med. Ent. 13:429-440.
- Kirk, R. and D.J. Lewis  
1951. The Phlebotominae of the Ethiopian Region. Trans. Roy. Ent. Soc. Lond. 102:383-510.
- Knab, F.  
1913. A new American *Phlebotomus*. Ins. Ins. Mens. 1:135-137.
- Lainson, R. and J.J. Shaw  
1968. Leishmaniasis in Brazil. I. Observations on enzootic rodent leishmaniasis -- Incrimination of *Lutzomyia flaviscutellata* (Mangabeira) as the vector in the lower Amazonian Basin. Trans. Roy. Soc. Trop. Med. Hyg. 62:385-395.
1973. Leishmanias and leishmaniasis of the New World, with particular reference to Brazil. Bull. Pan-Am. Hlth. Organ. 7:1-19.
- Lainson, R., J.J. Shaw, R.D. Ward, and H. Fraiha  
1973. Leishmaniasis in Brazil: IX. Considerations on the *Leishmania braziliensis* complex: - Importance of sandflies of the genus *Psychodopygus* (Mangabeira) in the transmission of *L. braziliensis braziliensis* in north Brazil. Trans. Roy. Soc. Trop. Med. Hyg. 67:184-196.
- Lainson, R., R.D. Ward, and J.J. Shaw  
1976. Cutaneous leishmaniasis in north Brazil: *Lutzomyia anduzei* as a major vector. Trans. Roy. Soc. Trop. Med. Hyg. 70:171-172.
- Lainson, R., R.D. Ward, D.G. Young, J.J. Shaw, and H. Fraiha  
1977. Preliminary entomological and parasitological studies in Humboldt, Aripuana, Mato Grosso State, Brazil. Bol. INPA Path. Trop. (in press).
- Larrousse, F.  
1922. Nouvelle espèce américaine du genre *Phlebotomus*, *Ph. tejerae*, et tableau permettant de déterminer les mâles des différentes espèces de ce genre. Bull. Soc. Zool. France 47:41-46.

- Leon, M.P.  
1968. Acerca de tres especies de *Phlebotomus* (Diptera, Psychodidae), nuevas para Venezuela. Rev. Fac. Med., Maracaibo 1:29-35.
- Lewis, D.J.  
1965. Internal structural features of some Central American phlebotomine sandflies. Ann. Trop. Med. Parasit. 59: 375-385.
- 1967a. Phlebotomine sand-flies from Cayman Brac Island (Diptera: Psychodidae). J. Nat. Hist. 2:73-83.
- 1967b. Redescriptions of two South American sandflies (Diptera: Psychodidae). Proc. Roy. Ent. Soc. Lond. (B) 36:131-136.
1973. Phlebotomidae and Psychodidae (sand-flies and moth flies), p. 155-179. In K.G.V. Smith (ed.) Insects and other arthropods of medical importance. Pub. No. 720, British Mus. (Nat. Hist.) London. 561 p.
1974. The biology of Phlebotomidae in relation to leishmaniasis. Ann. Rev. Ent. 19:363-384.
- 1975a. Functional morphology of mouthparts in New World phlebotomine sandflies (Diptera: Psychodidae). Trans. Roy. Soc. Lond. 126:497-532.
- 1975b. The *Lutzomyia flaviscutellata* complex (Diptera: Psychodidae). J. Med. Ent. 12:363-368.
- Lewis, D.J. and P.C.C. Garnham  
1959. The species of *Phlebotomus* (Diptera: Psychodidae) in British Honduras. Proc. Roy. Ent. Soc. Lond. (B) 28:79-89.
- Lewis, D.J., R. Lainson, and J.J. Shaw  
1970. Determination of parous rates in phlebotomine sandflies with special reference to Amazonian species. Bull. Ent. Res. 60:209-219.
- Lewis, D.J., D.G. Young, G.B. Fairchild, and D.M. Minter  
1978. Proposals for a stable classification of the phlebotomine sandflies (Diptera: Psychodidae). Syst. Ent. 3 (in press).
- Llanos, B.Z.  
1964. Flebotomos de la Amazonia Peruana, con la descripcion de tres especies nuevas (Diptera, Psychodidae). Rev. Brasil. Biol. 24:371-382.
1973. Flebotomos de la selva Peruana (Diptera: Psychodidae). Rev. Peru. Ent. 16:29-50.

Llanos, R.Z., A.V. Martins, and J. da Silva

1975a. Estudos sobre os flebotomíneos do Péru (Diptera, Psychodidae, Phlebotominae) 1. Departamento de Cuzco; 2. Descrição das fêmeas de *Lutzomyia campbelli* e *Lutzomyia sherlocki* e redescricao do macho e descricao da fêmea de *Lutzomyia octavioi*. Rev. Brasil. Biol. 35:655-664.

1975b. Estudos sobre os flebotomíneos do Péru (Diptera, Psychodidae, Phlebotominae) 1. Departamento de Cuzco; 3. Descrição do macho e redescricao da fêmea de *Lutzomyia (Psychodopygus) amazonensis* (Root, 1934) e lista das espécies coletadas. Rev. Brasil. Biol. 35:665-672.

1976. Estudos sobre os flebotomíneos do Péru. II. Departamento de Madre de Dios: Lista das especies coletadas e descricao das fêmeas de *Lutzomyia micropygæ* (Mangabeira, 1942) e *Lutzomyia calcarata* Martins e Silva, 1964 (Diptera, Psychodidae, Phlebotominae). Ref. Brasil. Biol. 36:479-485.

Lucena, D.T.

1967. Flebotomos do nordeste. III. Mais três espécies da fauna Pernambucana (Diptera, Psychodidae). Rev. Bras. Malar. Doenç. Trop. 19:271-282.

Lucena, D.T. and L. Almeida

1964. Flebotomos do nordeste. I. Encontro de "*Phlebotomus shoti*," "*P. aragaoi*" e "*P. longispinus*" em Pernambuco (Diptera, Psychodidae). Rev. Brasil. Biol. 24:184-192.

Lutz, A. and A. Neiva

1912. Contribuição para o conhecimento das espécies do genero *Phlebotomus* existentes no Brasil. Mem. Inst. Oswaldo Cruz 4:84-95.

Mangabeira, F.O.

1941a. Contribuição ao estudo dos *Flebotomus*. *Psychodopygus* n.subg. (Diptera: Psychodidae). Mem. Inst. Oswaldo Cruz 36:237-250.

1941b. Contribuição ao estudo dos *Flebotomus*. *Viannamyia* n.sub. (Diptera: Psychodidae). Mem. Inst. Oswaldo Cruz 36:251-262.

1942a. Contribuição ao estudo dos *Flebotomus* (Diptera: Psychodidae). Descrição dos machos de 24 novas espécies. Mem. Int. Oswaldo Cruz 37:111-218.

1942b. Contribuição ao estudos dos *Flebotomus* (Diptera: Psychodidae). *Flebotomus (Brumptomyia) avellari* Costa Lima, 1932. Mem. Inst. Oswaldo Cruz 37:226-240.

1942c. Contribuição ao estudo dos *Flebotomus* (Diptera, Psychodidae). *Flebotomus (Pressatia) triacanthus* Mangabeira, 1942. Mem. Inst. Oswaldo Cruz 37:241-250.

Mangabeira, F.O.

1942d. Contribuição ao estudo dos *Phlebotomus* (Diptera, Psychodidae). *Phlebotomus longispinus* Mangabeira, 1942. Mem. Inst. Oswaldo Cruz 37:251-257.

1942e. Contribuição ao estudo dos *Phlebotomus* (Diptera: Psychodidae). *Phlebotomus nordestinus* n.sp. Mem. Inst. Oswaldo Cruz 37: 327-331.

Mangabeira, F.O. and I.A. Sherlock

1962. Sobre o *Phlebotomus brasiliensis* Costa Lima, 1932 (Diptera, Psychodidae). Mem. Inst. Oswaldo Cruz 60:311-319.

Martins, A.V.

1970. *Lutzomyia* (*Psychodopygus*) *fairtigi* n.sp. from Colombia (Diptera: Psychodidae: Phlebotominae). Proc. Ent. Soc. Wash. 72:279.

Martins, A.V., A.L. Falcão, and J.E. da Silva

1961a. Estudos sobre os flebotomos do Estado de Minas Gerais.

III. Descrição de "*Lutzomyia appendiculata*" sp.n. (Diptera, Psychodidae). Rev. Brasil. Biol. 21:297-300.

1962a. Nota sobre os flebotomos do Estado de Goiás, com a descrição de duas espécies novas e da fêmea de *Lutzomyia longipennis* (Barretto, 1946) e a redescricao do macho da *L. evandroi* (Costa Lima e Antunes, 1936) (Diptera, Psychodidae). Rev. Brasil. Malar. Doenc. Trop. 379-401.

1963. Notas sobre os flebotomos do Território de Roraima, com a descrição de três novas espécies (Diptera, Psychodidae). Mem. Inst. Oswaldo Cruz 23:333-348.

1964. Estudos sobre os flebotomos do Estado de Minas Gerais. VI. Descrição de "*Lutzomyia termitophila*" sp.n. e "*Lutzomyia cipoensis*" sp.n. (Diptera, Psychodidae). Rev. Brasil. Biol. 24:309-315.

1965. Notas sobre os flebotomos do Território de Rondônia, com a descrição de seis espécies novas (Diptera, Psychodidae). Rev. Brasil. Biol. 25:1-20.

1973a. Sobre *Lutzomyia* (*Psychodopygus*) *paraensis* (Costa Lima, 1941) e algumas espécies afins (Diptera, Psychodidae, Phlebotominae). Rev. Brasil. Biol. 33:411-418.

1973b. Nota sobre *Lutzomyia* (*Psychodopygus*) *davisi* (Root, 1934) (Diptera, Psychodidae, Phlebotominae), com a descrição da fêmea. Rev. Brasil. Biol. 33:419-425.

1975. *Lutzomyia schreiberi* n.sp., nova espécie de flebotomideo afim de *Lutzomyia micropyga* (Mangabeira, 1942) (Diptera, Psychodidae, Phlebotomidae). Ciênc. Cult., S. Paulo 27:766-772.

Martins, A.V. and H. Fraiha

1971. *Lutzomyia evangelistai* sp.n., nova espécie de phlebotomo do Estado do Pará (Diptera, Psychodidae Phlebotominae). Rev. Brasil. Biol. 31:361-365.

Martins, A.V., T.L. Godoy, Jr., and J.E. da Silva

- 1961b. Nota sobre os flebotomos dos Estados do Paraná e Santa Catarina, com a redescricao da *Lutzomyia gaminari* (Cordero, Vogelsang e Cossio, 1928) (Diptera, Psychodidae). Rev. Brasil. Biol. 21:309-316.

- 1962b. Uma nova espécie de flebotomo dos Estados do Rio de Janeiro e Espirito Santo -- *Lutzomyia gasparvianai* n.sp. (Diptera, Psychodidae). Rev. Inst. Med. Trop. S. Paulo 4:85-90.

Martins, A.V., B.Z. Llanos, and J.E. da Silva

- 1976a. Estudos sobre os flebotomíneos do Perú. III. Departamento de Huánuco: Lista das espécies coletadas e descrição de duas espécies novas, *Lutzomyia elegans* n.sp. e *Lutzomyia ruparupa* n.sp. (Diptera, Psychodidae, Phlebotominae). Rev. Brasil. Biol. 36:487-494.

- 1976b. Estudos sobre os flebotomíneos do Peru. IV. Departamento de Loreto: Lista das espécies coletadas, descrição de uma espécie nova, *Lutzomyia omagua* n.sp. e redescricao do macho de *Lutzomyia scaffi* (Damasceno & Arouck, 1956) (Diptera, Psychodidae, Phlebotominae). Rev. Brasil. Biol. 36:495-501.

Martins, A.V., C.S. Maciel, and J.E. da Silva

1968. Notas sobre os flebotomos do grupo *squamiventris* do subgenero *Psychodopygus* Mangabeira, 1941 (Diptera, Psychodidae). Bol. Mus. Hist. Nat. Univ. Fed. Minas Gerais, No. 1. 28 p.

Martins, A.V. and E.N. Morales

1972. Sobre a distribuicao geografica dos flebotomíneos Americanos (Diptera, Psychodidae, Phlebotominae). Rev. Brasil. Biol. 32:361-371.

Martins, A.V. and J.E. da Silva

1964. Notas sobre os flebotomos do Estado do Acre, com a descricao de duas espécies novas (Diptera, Psychodidae). Rev. Brasil. Biol. 24:127-138.

1965. Estudos sobre os flebotomos do Estado de Minas Gerais. VII. Descrição de "*Lutzomyia callipygus*" sp.n. de "*Lutzomyia diacantha*" sp.n. (Diptera, Psychodidae). Rev. Brasil. Biol. 25:269-276.

Martins, A.V., J.E. da Silva, and A.L. Falcão

1970. Estudos sobre os flebotomos do Estado de Minas Gerais. VII. Descrição de duas novas especies, *Lutzomyia hermanlenti* sp.n. e *Lutzomyia oliveirai* sp.n. (Diptera: Psychodidae, Phlebotominae). Rev. Brasil. Biol. 30:547-553.

- Martins, A.V., J.E. da Silva, and A.L. Falcão  
1971. *Lutzomyia sherlocki* sp.n., do Estado de Mato Grosso, Brasil (Diptera, Psychodidae, Phlebotominae). Rev. Brasil. Biol. 31:415-418.
- McConnell, E.  
1962. Leptomonads of wild-caught Panamanian *Phlebotomus*: Culture and animal inoculation. Exp. Parasit. 14:123-128.
- McConnell, E. and M. Correa  
1964. Trypanosomes and other microorganisms from Panamanian *Phlebotomus* sandflies. J. Parasit. 50:523-528.
- Miles, C.T., W.A. Foster, and H.A. Christensen  
1976. Mating aggregations of male *Lutzomyia* sandflies at human hosts in Panama. Trans. Roy. Soc. Trop. Med. Hyg. 70: 531-532.
- Mirsa, A.  
1953. Sobre la biología de algunos flebótomos (Diptera, Psychodidae) y datos sobre otros hematofagos colectados en Altigracia de Ortiaco (Estado Guárico, Venezuela). Rev. Venez. Sanid. Asist. Soc. 18:63-70.
- Mirsa, A. and I. Ortiz  
1952. *Phlebotomus foliatus* n.sp. (Diptera, Psychodidae) un nuevo flebótomo de Venezuela. Rev. Venez. Sanid. Asist. Soc. 17:249-252.
- Morales-Alarcon, A., E. Osorno-Mesa, and F. de Osorno  
1969a. Phlebotominae de Colombia (Diptera, Psychodidae). II. Sobre algunos *Phlebotomus* de los llanos orientales. Caldasia 10:377-382.
- Morales-Alarcon, A., F. de Osorno, and E. Osorno-Mesa  
1974. Phlebotominae de Colombia. X. Descripción de la hembra de *Lutzomyia dendrophila* (Mangabeira, 1942) y del macho y la hembra de *Lutzomyia disiuncta* sp.n. (Diptera, Psychodidae). Rev. Brasil. Biol. 34:443-452.
- Morales-Alarcon, A., E. Osorno-Mesa, F. de Osorno, and M. de Hoyos  
1969b. Phlebotominae de Colombia (Diptera, Psychodidae). V. Descripción de una nueva especie de *Lutzomyia*. Rev. Acad. Colomb. Cienc. Exact. Fis. Nat. 13:383-390.
- Newstead, R.  
1914. Notes on *Phlebotomus* with descriptions of new species. Part II. Bull. Ent. Res. 5:188-190.
1922. A new species of *Phlebotomus* from Trinidad. Ann. Trop. Med. Parasit. 16:47-50.

Nitzulescu, V.

1931. Sur un phlébotome nouveau du Venezuela. *P. gomezi* n.sp.  
Ann. Parasit. Hum. Comp. 9:247-255.

Núñez-Tovar, M.

1924. Mosquitos y flebotomos de Venezuela. Lit. & Tip. Comercio,  
Caracas. 46 p.

Ortiz, I.

1952. Sobre dos nuevas machos del genero *Phlebotomus* (Diptera, Psychodidae). Rev. Venez. Sanid. Asist. Soc. 17:153-158.
1954. Descripcion de dos nuevas especies del genero *Phlebotomus* Rondani (Diptera, Psychodidae) de Venezuela. Acta Biol. Venez. 1:231-250.
1963. Sobre algunos caracteres morfologicos de probable valor taxonomico en la identification de las hembras del subgenero *Brumptomyia* França y Parrot, 1921 (Diptera: Psychodidae), con la descripcion de la hembra de *Phlebotomus (Brumptomyia) beaupertuyi*, Ortiz, 1954. Rev. Venez. Sanid. Asist. Soc. 28:319-324.
- 1965a. Contribucion al estudio de los *Flebotomos* Americanos del grupo *cayennensis* con la descripcion de una nueva especie: *Phlebotomus yencanensis* n.sp. (Diptera, Psychodidae). Acta Biol. Venez. 4:205-211.
- 1965b. Contribucion al estudio de los *Flebotomos* Americanos del grupo *sanguinari* con la descripcion de una nueva especie: *Phlebotomus scorzai* n.sp. (Diptera, Psychodidae). Acta Biol. Venez. 5(2):25-39.
- 1965c. *Phlebotomus hernandezii* n.sp. del Estado Trujillo, Venezuela (Diptera, Psychodidae). Arch. Venez. Med. Trop. Parasit. Med. 5:411-418.
- 1972a. *Phlebotomus pifanoi* nov. sp. nueva especie de *Phlebotomus* (Diptera: Psychodidae) de la region sur-este Amazonica Venezolana. Rev. Inst. Nac. Hyg., Caracas 5:21-26.
- 1972b. Revision de los flebotomos Americanos del subgenero *Psychodopygus* Mangabeira, 1941 (Diptera: Psychodidae). Rev. Nac. Hyg., Caracas 5:221-249.

Ortiz, I. and A. Alvarez

- 1963a. Sobre un nuevo *Phlebotomus* (*P. ceferinoi* nov.sp.) de Venezuela (Insecta: Diptera, Psychodidae). Salud Publ., Caracas 5: 285-288.
- 1963b. Sobre los *Phlebotomus* Americanos de cinco espinas con la descripcion de una nueva especie (*Phlebotomus ceferinoi*, sp.nov.) de Venezuela (Diptera, Psychodidae). Rev. Venez. Sanid. Asist. Soc. 28:311-314.



Ortiz, I. and A. Alvarez

1972. *Phlebotomus parinaensis*, una nueva hembra de *Psychodopygus* Mangabeira, 1941 de Venezuela (Diptera: Psychodidae). Rev. Inst. Nac. Hyg., Caracas 5:139-145.

Ortiz, I. and J.V. Scorza

1963. Notas biológicas y taxonomicas sobre algunos Phlebotominae (Diptera, Psychodidae) de Rancho Grande, Venezuela. Acta Biol. Venez. 3:341-361.

Osorno-Mesa, E., A. Morales-Alarcon, and F. de Osorno

1967. Phlebotominae de Colombia (Diptera, Psychodidae). I. Distribucion geográfica de especies de *Phlebotomus* registradas con algunas anotaciones biológicas y descripción de una nueva. Caldasia 10:27-38.

1969. Phlebotominae de Colombia (Diptera, Psychodidae). IV. *Lutzomyia longipalpis* (Lutz & Neiva, 1912) en Colombia, S.A. Rev. Acad. Colomb. Cienc. Exact. Fis. Nat. 13:379-382.

- 1972c. Phlebotominae de Colombia (Diptera, Psychodidae). VIII. Descripción de *Lutzomyia sauroidea* sp.n. y *Lutzomyia caprina* sp.n. Rev. Brasil. Biol. 32:433-441.

Osorno-Mesa, E., A. Morales-Alarcon, F. de Osorno, and C. Ferro-Vela

- 1972a. Phlebotominae de Colombia (Diptera, Psychodidae). IX. Distribucion geográfica de especies de *Brumptomyia* França & Parrot, 1921 y *Lutzomyia* França, 1924 encontradas en Colombia, S.A. Rev. Acad. Colomb. Cienc. Exact. Fis. Nat. 14:5-81.

Osorno-Mesa, E., A. Morales-Alarcon, F. de Osorno, and P. Munoz de Hoyos

1970. Phlebotominae de Colombia (Diptera, Psychodidae). VI. Descripción de *Lutzomyia longiflocosa* n.sp. y *Lutzomyia bifoliata* n.sp. Bol. Mus. Nat. Hist. Univ. Fed. Minas Gerais, No. 6. 18 p.

Osorno-Mesa, E., F. de Osorno, and A. Morales-Alarcon

1966. A technique for permanent mounts of *Phlebotomus* applicable to other small insects. J. Med. Ent. 3:124-126.

- 1972b. Phlebotominae de Colombia (Diptera, Psychodidae). VII. Descripción de *Lutzomyia andina* sp.n. y *Lutzomyia quasi-townsendi* sp.n. Bol. Mus. Nat. Hist. Univ. Fed. Minas Gerais, No. 12. 21 p.

Pifano, F. and I. Ortiz

1952. Representantes Venezolanos del género *Phlebotomus* Rondani, 1840 (Diptera, Psychodidae). Rev. Venez. Sanid. Asist. Soc. 17:135-151.

1965. Bases taxonomicas para la identificación de *Phlebotomus antropofilos* vivos de la selva de Guatopo, Venezuela. Arch. Venez. Med. Trop. Parasit. Med. 5:421-425.



Pifano, F. and I. Ortiz

1972. *Phlebotomus gibsoni* nov.sp. (Diptera: Psychodidae) nuevo representante de la biota Amazonica Venezolana. Rev. Inst. Nac. Hyg. 5:29-35.

Pifano, F., I. Ortiz, and A. Alvarez

1960. La ecologia, en condiciones naturales y de laboratorio, de algunas especies de *Phlebotomus* de la region de Guatopo, Estado Miranda, Venezuela, con especial referencia al *Phlebotomus panamensis* Shannon, 1926: Transmisor de la leishmaniasis tegumentaria en Venezuela. Arch. Venez. Med. Trop. Parasit. Med. 3:62-71.
1962. Bases taxonomicas para el conocimiento de los *Phlebotomus* de la region de Guatopo, Venezuela. Arch. Venez. Med. Trop. Parasit. Med. 4:369-428.

Pifano, F., J. Romero Morrell, and A. Alvarez

1973. Comprobacion de una cepa de leishmania dermatropa en *Phlebotomus flaviscutellata* Mangabeira, 1942 de la Sierra Parima, Territorio Federal Amazonas, Venezuela. Arch. Venez. Med. Trop. Parasit. Med. 5:146-167.

Porter, C.H.P. and G.R. Defoliart

- The man-biting activity of phlebotomine sandflies (Diptera: Psychodidae) in a tropical wet forest environment in Colombia. Unpublished manuscript. 123 p.

Quate, L.W.

1963. Fossil Psychodidae in Mexican amber, Part 2 (Diptera: Insecta). J. Paleont. 37:110-118.

Quate, L.W. and W.A. Steffan

1966. An alternate method of mounting *Phlebotomus* and other small Diptera. J. Med. Ent. 3:126.

Ramirez J., A.V. Martins, and A. Ramirez

1976. *Lutzomyia convitti* n.sp. de flebotomineo de Venezuela (Diptera, Psychodidae, Phlebotominae). Rev. Brasil. Biol. 36:599-603.

Reyes, G.G.

1957. Algunos aspectos de la leishmania observados en al hospital de San Juan de Dios de Bogota. Rev. Fac. Med. Univ. Nac. Colomb. 25:371-91.

Ristorcellei, A. and D. Van Ty

1941. Phlébotomes d'une région de Colombie ou la verruga du Pérou est devenue endémique depuis deux ou trois ans (seconde note). Ann. Parasit. Hum. Comp. 18:251-269.

Rodríguez, M.J.D.

1950. Los *Phlebotomus* del Ecuador (Diptera, Psychodidae). I. Consideraciones generales. Descripción de una nueva especie. Rev. Ecuat. Hyg. Med. Trop. 7:1-10 (not published until 1952).
- 1953a. Observación del *P. dysponetus* Fairchild y Hertig 1952 en cópula. Rev. Ecuat. Hyg. Med. Trop. 10:25-26.
- 1953b. Los *Phlebotomus* del Ecuador (Diptera, Psychodidae). III. Descripción de una nueva especie. Rev. Ecuat. Hyg. Med. Trop. 10:51-55.
1956. Los *Phlebotomus* del Ecuador (Diptera, Psychodidae). VI. Nuevas capturas. Descripción de una nueva especie. Resumen y distribución geográfica. Rev. Ecuat. Hyg. Med. Trop. 13:75-83.

Root, F.M.

1934. Some American species of *Phlebotomus* with short terminal Palpal segments. Amer. J. Hyg. 20:233-246.

Rosabal, R.

1954. Contribucion al estudio de los *Phlebotomus* de Costa Rica (Diptera, Psychodidae). Thesis, Univ. Costa Rica, Ministerio Salubr. Publ., No. 3. 55 p.
1966. Contribucion al estudio de los *Phlebotomus* de Costa Rica (Diptera, Psychodidae). II. Presencia de *P. barretto* y *P. ovallesi* en Costa Rica. Rev. Biol. Trop. 14:1-2.

Rosabal, R. and A. Trejos

1964. *Phlebotomus* de El Salvador (Diptera, Psychodidae). I. Especies conocidas. Rev. Biol. Trop. 12:167-173.
1965. *Phlebotomus* de El Salvador (Diptera, Psychodidae). II. Observaciones sobre su biología con especial referencia a *P. longipalpis*. Rev. Biol. Trop. 13:219-228.

Rozeboom, L.E.

1940. *Phlebotomus suis*, a new *Phlebotomus* from Panama (Diptera: Psychodidae). Amer. J. Hyg. 32:8-11.
- 1947a. Taxonomic notes concerning *Phlebotomus osornoi* Ristorcelli and Van Ty, 1941 (Diptera, Psychodidae). Proc. Ent. Soc. Wash. 49:177-182.
- 1947b. The identity of the *Phlebotomus* associated with the bartonellosis in Colombia. Ann. Ent. Soc. Amer. 40:705-714.

Rutledge, L.C. and D.A. Ellenwood

- 1975a. Production of Phlebotomine sandflies on the open forest floor in Panama. The species complement. Environ. Ent. 4:71-77.

Rutledge, L.C. and D.A. Ellenwood

- 1975b. Production of phlebotomine sandflies on the open forest floor in Panama: Hydrologic and physiographic relations. Environ. Ent. 4:78-82.

- 1975c. Production of phlebotomine sandflies on the open forest floor in Panama: Phytologic and edaphic relations. Environ. Ent. 4:83-89.

Rutledge, L.C., D.A. Ellenwood, and L. Johnston

1975. An analysis of sandfly light trap collections in the Panama Canal Zone (Diptera: Psychodidae). J. Med. Ent. 12:179-183.

Rutledge, L.C. and H.L. Mosser

1972. Biology of immature sandflies. (Diptera: Psychodidae) at the bases of trees in Panama. Environ. Ent. 1:300-309.

1975. Notes on the host ranges of some phlebotomine sandflies in Panama. Mosquito News 35:410-411.

Sæther, O.A.

1971. Notes on the general morphology and terminology of the Chironomidae (Diptera). Can. Ent. 103:1237-1260.

Samaniego, B.N.

1944. Comision de estudios sobre bartoneliosis. Pasto-Nariño-Colombia. Situacion actual y programa. Rev. Fac. Med. Univ. Nac. Colomb. 13:523-530.

Schneider, C.R. and M. Hertig

1966. Immunodiffusion reactions of Panamanian Leishmania. Exp. Parasit. 18:25-34.

Schultz, M.G.

1968. A history of bartoneliosis (Carrion's disease). Amer. J. Trop. Med. Hyg. 17:503-515.

Scorza, J.V., I. Gomez, and M. Ramirez

1968. Observaciones biologicas sobre algunos flebotomos de "Rancho Grande" (Venezuela). 3. Notas bionomicas sobre *Phlebotomus townsendi* Ortiz, 1959 y *P. vexillarius* Fairchild and Hertig, 1952. Acta Biol. Venez. 6:28-40.

Scorza, J.V. and I. Ortiz

1960. On microclimatic conditions of the habitats of certain sandfly species (Diptera, Psychodidae) from Venezuela. Z. Tropenmed. Parasit. 11:433-440.

Scorza, J.V., I. Ortiz, and M.T. McLure

1963. Ecologia de las formas estacionales de *Phlebotomus townsendi* Ortiz, 1960 y *Phlebotomus cayennensis* Floch & Abonnenc, 1941 (Diptera, Psychodidae) en el centro-norte de Venezuela. Acta Biol. Venez. 3:437-453.

- Scorza, J.V., I. Ortiz, and M. Ramirez  
1967. Observaciones biológicas sobre algunos flebotomos de Rancho Grande (Venezuela). I. Descripción de un área restringida de la selva nublada y taxonomía de los *Phlebotomus* (Diptera, Psychodidae). Acta Biol. Venez. 5:179-200.
- Shannon, R.C.  
1926. The occurrence of *Phlebotomus* in Panama. J. Wash. Acad. Sci. 16:190-193.  
1939. Methods for collecting and feeding mosquitoes in jungle yellow fever studies. Amer. J. Trop. Med. 19:131-138.
- Shaw, J.J.  
1964. A possible vector of *Endotrypanum schaudini* of the sloth *Choleopus hoffmanni*, in Panama. Nature 201:417-418.
- Shaw, J.J. and R. Lainson  
1972. Leishmaniasis in Brazil. VI. Observations on the seasonal variations of *Lutzomyia flaviscutellata* in different types of forest and its relationship to enzootic rodent leishmaniasis (*Leishmania mexicana amazonensis*). Trans. Roy. Soc. Trop. Med. Hyg. 66:709-717.
- Shaw, J.J., R. Lainson, and R.D. Ward  
1972. Leishmaniasis in Brazil. VII. Further observations on the feeding habits of *Lutzomyia flaviscutellata* (Mangabeira) with particular reference to its biting habits at different heights. Trans. Roy. Soc. Trop. Med. Hyg. 66:718-723.
- Sherlock, I.A.  
1962. Sobre alguns *Phlebotomus* e *Brumptomyia* da Colômbia (Diptera, Psychodidae). Mem. Inst. Oswaldo Cruz 60:321-336.
- Sherlock, I.A. and M. Carneiro  
1962. Algumas fêmeas de *Phlebotomus* do Brasil (Diptera, Psychodidae). Mem. Inst. Oswaldo Cruz 60:423-435.  
1964. Observações sobre o aparelho genital interno do macho de alguns "Phlebotominae" (Diptera, Psychodidae). Rev. Brasil. Biol. 24:203-210.
- Sherlock, I.A. and N. Guitton  
1970. Notas sobre o subgenero *Trichophoromyia* Barretto, 1961 (Diptera, Psychodidae, Phlebotominae). Rev. Brasil. Biol. 30:137-149.
- Sherlock, I.A. and S.B. Pessoa  
1964. Métodos práticos para a captura de flebotomos. Rev. Brasil. Biol. 24:331-340.  
1966. Lepromonas infectando naturalmente *Phlebotomus* em Salvador (Bahia, Brasil). Rev. Lat.-Amer. Microbiol. 8:47-50.

Saunders, R.E.

1935. Principles of insect morphology. McGraw-Hill, New York and London. 667 p.

Strangways-Dixon, J. and R. Lainson

1962. Dermal leishmaniasis in British Honduras: Transmission of *L. brasiliensis* by *Phlebotomus* species. Brit. Med. J. 1:297-299.

1966. The epidemiology of dermal leishmaniasis in British Honduras. Part III. The transmission of *L. mexicana* to man by *Phlebotomus pessoanus* with observations on the development of the parasite in different species of *Phlebotomus*. Trans. Roy. Soc. Trop. Med. Hyg. 60:192-201.

Sudia, W.D. and R.W. Chamberlain

1962. Battery light trap, an improved model. Mosquito News 22: 125-129.

Tesh, R.E. and B.N. Chaniotis

1975. Transovarial transmission of viruses by phlebotomine sandflies. Ann. N.Y. Acad. Sci. 266:125-134.

Tesh, R.E., B.N. Chaniotis, M.D. Aronson, and K.M. Johnson

- 1971a. Natural host preferences of Panamanian phlebotomine sandflies as determined by precipitin test. Amer. J. Trop. Med. Hyg. 20:150-156.

Tesh, R.E., B.N. Chaniotis, B.R. Carrera, and K.M. Johnson

1972. Further studies on the natural host preferences of Panamanian phlebotomine sandflies. Amer. J. Epidemiol. 95:88-93.

Tesh, R.E., B.N. Chaniotis, and K.J. Johnson

- 1971b. Vesicular stomatitis virus, Indiana serotype: Multiplication in and its transmission by experimentally infected phlebotomine sandflies (*Lutzomyia trapidoi*). Amer. J. Epidemiol. 93:491-495.

Tesh, R.E., B.N. Chaniotis, P.H. Peralta, and K.M. Johnson

1974. Ecology of viruses isolated from Panamanian phlebotomine sandflies. Amer. J. Trop. Med. Hyg. 23:258-269.

Thatcher, V.E.

- 1968a. Studies of phlebotomine sandflies using castor oil traps baited with Panamanian animals. J. Med. Ent. 5:293-297.

- 1968b. Arboreal breeding sites of phlebotomine sandflies in Panama. Ann. Ent. Soc. Amer. 61:1141-1143.

Thatcher, V.E. and M. Hertig

1966. Field studies on the feeding habits and diurnal shelters of some *Phlebotomus* sandflies (Diptera: Psychodidae) in Panama. Ann. Ent. Soc. Amer. 59:46-52.

- Theiler, M.T. and W.G. Downs  
1973. The arthropod-borne viruses of vertebrates. Yale Univ. Press, New Haven. 578 p.
- Theodor, O.  
1948. Classification of the Old World species of the subfamily Phlebotominae (Diptera, Psychodidae). Bull. Ent. Res. 39:85-115.  
1965. On the classification of American Phlebotominae. J. Med. Ent. 2:171-197.
- Tikasingh, E.S.  
1975. Observations on *Lutzomyia flaviscutellata* (Mangabeira) (Diptera: Psychodidae), a vector of enzootic leishmaniasis in Trinidad, West Indies. J. Med. Ent. 12:228-232.
- Townes, H.  
1962. Design for a Malaise trap. Proc. Ent. Soc. Wash. 64:253-262.
- Vargas, L. and A. Diaz-Nájera  
1951a. *Phlebotomus pratti*, n.sp. de Iguala, Estado de Guerrero (Insecta: Diptera). Bol. Inst. Estud. Med. Biol. Univ. Nac. Méx. 9:19-23.  
1951b. *Phlebotomus beltrani* n.sp. y *Phlebotomus wirthi* n.sp. del Estado de Veracruz (Diptera: Psychodidae). Rev. Inst. Salubr. Enferm. Trop. Méx. 12:101-106.  
1952. Dos flebotomos nuevos de Mexico (Diptera, Psychodidae). Rev. Soc. Mex. Hist. Nat. 13:63-74.  
1953a. Nuevas especies de *Flebotomus* de Mexico. Rev. Inst. Salubr. Enferm. Trop., Méx. 13:41-52.  
1953b. Lista de flebotomos Mexicanos y su distribución geográfica (Diptera: Psychodidae). Rev. Inst. Salubr. Enferm. Trop. Méx. 13:309-314.  
1959. *Phlebotomus farilli* n.sp., *Ph. humboldti* n.sp. y *Ph. olmecus* n.sp. de Mexico (Diptera: Psychodidae). Rev. Inst. Salubr. Enferm. Trop., Méx. 19:141-159.
- Velasco, J.E.  
1973. The phlebotomine sandflies of the Los Yungas region of Bolivia. M.S. Thesis, Louisiana State Univ., Dep. Trop. Med. & Med. Parasit., 204 p.
- Velasco, J. and H. Trapido  
1974. Two new phlebotomine sandflies from Bolivia, *Lutzomyia boliviana* n.sp. and *Warsiya yungasi* n.sp. (Diptera, Psychodidae). J. Med. Ent. 11:433-436.

- Ward, R.D.  
1976. The immature stages of some phlebotomine sandflies from Brazil (Diptera: Psychodidae). Syst. Ent. 1:227-240.
1977. New World leishmaniasis: A review of the epidemiological changes in the last three decades. Proc. XV Int. Congr. Ent., Washington, 505-522.
- Ward, R.D. and H. Fraiha  
1977. *Lutzomyia umbratilis* n.sp. -- A sandfly previously identified as *L. anduzei* (Rozeboom, 1942) (Diptera: Psychodidae). J. Med. Ent. 14 (in press).
- Ward, R.D. and R. Killick-Kendrick  
1974. Field and laboratory observations on *Psychodopygus lainsoni* Fraiha & Ward and other sandflies (Diptera, Phlebotomidae) from the transamazônica highway, Pará State, Brazil. Bull. Ent. Res. 64:213-221.
- Ward, R.D., R. Lainson, and J.J. Shaw  
1977. Experimental transmissions of *Leishmania mexicana amazonensis* Lainson & Shaw, between hamsters by the bite of *Lutzomyia flaviscutellata* (Mangabeira). Trans. Roy. Soc. Trop. Med. Hyg. 71:265-266.
- Ward, R.D. and P. Ready  
1975. Chorionic sculpturing of some sandfly eggs (Diptera: Psychodidae). J. Ent. (A) 50:127-134.
- Ward, R.D., J.J. Shaw, and R. Lainson  
1973. Leishmaniasis in Brazil. VIII. Observations on the phlebotomine fauna of an area highly endemic for cutaneous leishmaniasis, in the Serra dos Carajás, Pará State. Trans. Roy. Soc. Trop. Med. Hyg. 67:174-183.
- Wijers, D.J.B. and J. Huisenga  
1967. A new species of *Lutzomyia* from Surinam (Diptera: Psychodidae). Bull. Ent. Res. 57:395-397.
- Wiyers, D.J.B. and R. Linger  
1966. Man-biting sandflies in Surinam (Dutch Guiana). *Phlebotomus anduzei* as a possible vector of *Leishmania braziliensis*. Ann. Trop. Med. Parasit. 60:501-508.
- Williams, P.  
1970. Phlebotomine sandflies and leishmaniasis in British Honduras (Belize). Trans. Roy. Soc. Trop. Med. Hyg. 64:317-368.
- 1976a. The phlebotomine sandflies (Diptera, Psychodidae) of the caves in Belize, Central America. Bull. Ent. Res. 65:601-614.
- 1976b. Flagellate infections in cave-dwelling sandflies (Diptera, Psychodidae) in Belize, Central America. Bull. Ent. Res. 65:615-629.

- Williams, P., D.J. Lewis, and P.C.C. Garnham  
1965. On dermal leishmaniasis in British Honduras. Trans. Roy. Soc. Trop. Med. Hyg. 59:64-71.
- Young, D.G.  
1972a. *Lutzomyia ignacioi*, a new species of phlebotomine sand fly from Venezuela (Diptera: Psychodidae). J. Med. Ent. 9: 312-314.  
1972b. Phlebotomine sand flies from Texas and Florida (Diptera: Psychodidae). Fla. Ent. 55:61-64.  
1973. Two new phlebotomine sand flies from Colombia (Diptera: Psychodidae). Fla. Ent. 56:106-112.
- Young, D.G. and J. Arias  
1977. *Lutzomyia* sand flies in the subgenus *Evandromyia* Mangabeira with a description of a new species from Brazil (Diptera: Psychodidae). Bol. INPA Path. Trop. (in press).
- Young, D.G. and B.N. Chaniotis  
1972. The male of *Varileya nigrosacculus* (Diptera: Psychodidae). Fla. Ent. 55:97-99.
- Young, D.G. and C.H. Porter  
1972. *Lutzomyia yuilli*, a new man-biting phlebotomine sand fly from Colombia (Diptera: Psychodidae). J. Med. Ent. 9:524-526.  
1974. *Lutzomyia cirrita* n.sp. from Colombia with a new synonym in the genus (Diptera: Psychodidae: Phlebotominae). Fla. Ent. 57:321-325.
- Zeledon, R. and M. Alfaro  
1973. Isolation of *Leishmania braziliensis* from a Costa Rican sandfly and its possible use as a human vaccine. Trans. Roy. Soc. Trop. Med. Hyg. 67:416-417.
- Zeledon, R. and R. Rosabal  
1969. *Trypanosoma leonidasdeane* sp.n. in insectivorous bats of Costa Rica. Ann. Trop. Med. Parasit. 63:221-223.
- Zimmerman, J.H., H.D. Newson, G.R. Hooper, and H.A. Christensen  
1977. A comparison of the egg surface structure of six anthropophilic phlebotomine sand flies (*Lutzomyia*) with the scanning electron microscope (Diptera: Psychodidae). J. Med. Ent. 13:574-479.



## BIOGRAPHICAL SKETCH

David Grier Young was born May 9, 1940, at Dayton, Ohio. In June, 1958, he was graduated from Oakwood High School, Dayton, Ohio. In December, 1962, he received the degree of Bachelor of Science with a major in entomology from the University of Florida. From 1963 to 1968, he served as a commissioned officer in the Medical Service Corps, U.S. Army at Ft. Sam Houston, Texas, and the Panama Canal Zone. Following his discharge, he worked on a research project involving small mammals and ectoparasites in Ohio (Dayton Museum of Natural History). In 1968, he enrolled in the Graduate School of the University of Florida, receiving the degree of Master of Science in June, 1971, with a major in entomology. From 1972 to December, 1977, he has been co-investigator and principal investigator of a U.S. Army Medical Research and Development contract dealing with the systematics of phlebotomine sand flies.

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David Young is married to the former Marianna Brown. They have twin sons, Alexander and Mark.

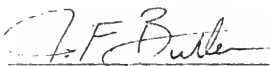
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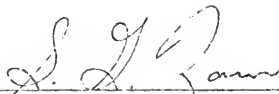
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Professor of Entomology and  
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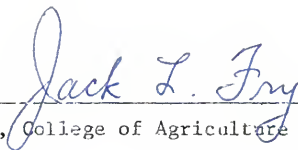
I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

A handwritten signature in blue ink, appearing to read "S. G. Zam", written over a horizontal line.

Dr. S.G. Zam  
Associate Professor of Microbiology

This dissertation was submitted to the Graduate Faculty of the College of Agriculture and to the Graduate Council and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

December 1977

A handwritten signature in blue ink, appearing to read "Jack L. Fry", written over a horizontal line.

Dean, College of Agriculture

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Dean, Graduate School

UNIVERSITY OF FLORIDA



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